REPORT ON
THE SURVEY AND THE BASIC PLANNING
FOR
THE U.A.E. MARICULTURE CENTER

May, 1979

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C O N T E N T S

I. INTRODUCTION

On the request of UAE government, two Japanese fisheries experts made a reconnaissance trip in UAE from 4 to 22 December, 1977 to find a possibility of aquaculture in the country.

Again from 9 May to 6 July, 1978, two experts including H. Ikenoue, one of members of the present survey mission, were dispatched to UAE to carry out a project finding survey concerning to the aquaculture development in the country.

The second mission carried out inspection trips covering all important places in the UAE coastline and made oceanoqraphical and biological surveys. Also fish market survey and interviews to fisheries officers and fishermen were conducted.

As the results of the survey, they reached to the following conclusions:

1. Considering the facts that there were few trained manpower and little background knowledge available for aquaculture in UAE, establishment of an institution which would carry out both the research-and-development of aquaculture techniques and the training personnels was recommendable as the initial stage for aquaculture development in UAE.
2. As the site to establish such institution, Umm Al Quwain was the most suitable place due to her favourable geographical situation and desirable oceanographic and biological features for aquaculture.
3. Shrimp, rabbitfish and mullet would be the most suitable aquaculture animals in UAE considering their market values and biological characters.
4. To give the idea of aquaculture and to stimulate interest in aquatic life in general, an aquarium opened for public was recommendable as an attached facility to the institution.
5. A project planning survey should be conducted at Umm Al Quwain to work out basic plannings of the institution. Three months and three experts would be required to carry out the survey during the period between January and April when spawning would be taken place for most of aquatic animals in the lagoon.

The present survey mission was dispatched on the request of UAE government to carry out the project planning survey mentioned above.

II. PURPOSE OF THE PRESENT SURVEY

The followings are the purpose of the present survey:

1. To carry out geographical, topographical, oceanographical and fisheries biological survey in Umm Al Quwain lagoon.
2. To carry out fisheries biological studies on shrimp, rabbitfish and mullet to know the exact spawning season, distribution of larvae or juveniles in the lagoon, food habit, availability of natural seeds for aquaculture and possibility of artificial seed production.
3. To carry out studies on the present conditions of fisheries in Umm Al Quwain.
4. To select suitable site to establish the above mentioned institution.
5. To make work plan, and personnel plan of the institution.
6. To work out basic designing of buildings and facilities of the institution.
7. To estimate the costs to establish and to maintain the institution.
8. To find the most feasible procedures to establish the institution.

III. MEMBERS OF THE SURVEY MISSION

Hiromu Ikenoue (Aquaculture engineer)	14 Feb. - 14 May, 1979
Shin Zamami (Oceanography engineer)	27 Feb. - 14 May, 1979
Toshiya Ogasawara (Architect)	17 Apr. - 14 May, 1979

IV. ACKNOWLEDGMENT

We wish to express our sincere gratitude to H.E. Mr. Mohammed Ragabani, Minister of Agriculture and Fisheries, and H.E. Mr. Hamad Salman ., Deputy Minister, for their great helps during the present survey.

Our thanks are specially due to Dr. Rifat Ali, Adviser of Ministry of Agriculture and Fisheries, for his cooperation in every possible way.

Mr. Sami Marjy, Fishery Biologist of Khor Fakkan Fisheries Laboratory, greatly helped us in field surveys. Mr. Abudullah Buharoun, Director of Fisheries Department, Mr. Mohammed Saeed, Head of Fisheries Section, Mr. Rasid Naser, Head of Umm Al Quwain Fisheries Office, Mr. Homeid Darwishi, Representative of Fishermen of Umm Al Quwain, Mr. Thomas Cherien, oceanographer of Khor Fakkan Fisheries Laboratory and all other staffs of fisheries Department provided us with various kinds of facilities. Our thank are due to all persons mentioned above.

V. RESULTS OF THE FIELD SURVEY

1. CHARACTERISTICS OF UMM Al QUWAIN LAGOON

1) Topography of the lagoon

Umm Al Quwain lagoon is 9 km in width from east to west and 7 km from north to south and about 50 km^2 in area. (Fig. 1). The lagoon has two openings to the Arabian Gulf, one in the west near the town and the other in the east. Depth of the lagoon is less than 10 m except a dredged area near the western opening. Although the lagoon shows complicated topographical features, the whole area can roughly be classified into three categories, i.e. islands, shallow area which is exposed or less than 1 m in depth at the low tide and deep area. Since the most of the area in the lagoon is categorized as shallow, the shape of the lagoon is considerably changed according to the tide levels.

Fig. 2 and Table 1 shows the locations of survey points where surveys were carried out on bottom quality, tidal water level, water current, water quality, plankton, and benthic fauna.

2) Bottom quality

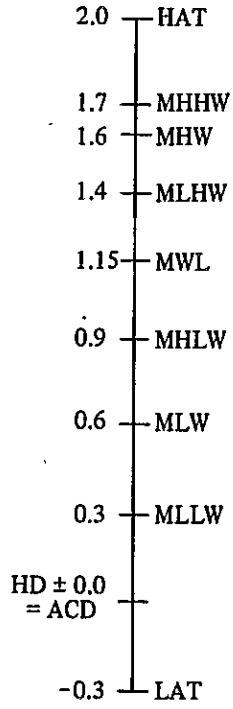
Bottom of the lagoon is mainly covered with a sand layer which sometimes contains shell and coral fragments. Sand of the deep area is coarser than that of the shallow area. The innermost part of the lagoon to the east of Homeidhi Is. is very muddy.

The bottom deposit was sampled on 16 April by an Ekman-Berge bottom sampler at deep area (Sts. 3 and 5) and by a scoop cup at shallow area (Sts. 2s, 3s, 4s 4m, and 5s) for the measurments of moisture content and ignition loss. The measurements were made by Soil and Water Department at Digdaga Experimental Farm. Moisture content was determined by heating the air-dry soil samples at 105°C for 24 hrs. Ingnition loss was determined by

heating dried samples at 550°C until weight became constant. The results are shown in Fig.3. The moisture content ranged between 0.22 and 2.47% and the ignition loss between 1.0 and 3.8%. Both moisture content and ignition loss are higher at the shallow Halodule area indicating richer organic matter accumulation at the area.

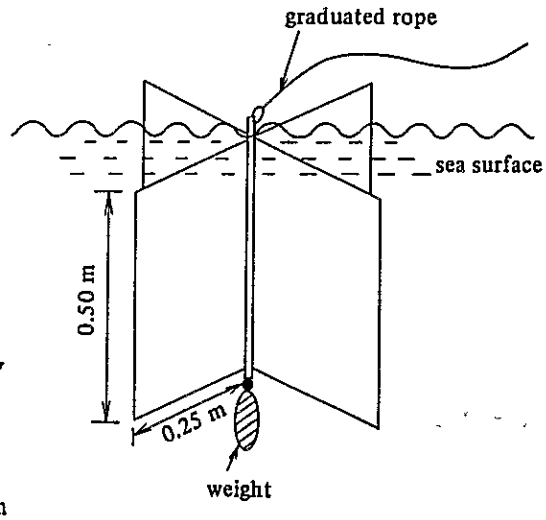
3) Tidal changes in water level

Difference between high and low water levels is about 1 m at the western opening of the lagoon as shown in the past data accummulated by Halcraw International (right). Tidal change in water level at the inner part of the lagoon was surveyed at St. 3, east of Chaebe Is., on 20 and 21 March. Water level was recorded by means of a graduated pole stand vertically on the sea bottom. The reading was made every one hour for 24 hrs. from 11 00, 20 March. The result of the survey is shown in Fig. 4, B together with time and height of high and low waters at the western opening of the lagoon predicted by the tide table (Halcrow International, 1979. Fig. 4, A). The time of high and low tides obtained at St. 3 coincides well to those in the tide table. The difference between water levels at high and low waters, however, was larger at St. 3 than that in the table probably due to the effect of topography of the lagoon to the tidal movement.



4) Water current

Water current in the lagoon was surveyed by means of a drifting panel (right). The current velocity was calculated from the distance drifted by the panel in a certain period of time. The current direction was read by a magnet conpass. Fig. 4, C shows the result of the water current survey carried out on 20 March at St. 3 in which the current velocity and direction were measured every one hour from 11 00. It can be seen from the Fig. that strong current toward the inner



part of the lagoon occurs when tide is flooding and reverse current toward the western opening, when ebbing. At the times of high and low tides, water becomes almost still. The strongest current observed during the survey was 0.72 m/sec. toward inner part of the lagoon.

The water current velocity and direction were measured at various survey points in the lagoon when the current became strongest during the flooding or ebbing tides. The measurment was carried out on 13 March for the neap tide and on 26 March for the spring tide. The results are shown in Fig. 5, A and B respectively. It can be said from the results that the current velocity in the lagoon seldom exceeds 1.0 m/sec. Direction of the current is toward the inner part of the lagoon when tide is flooding and toward the western opening when tide is ebbing at all survey points. As is expected, water current is stronger at the spring tide than at the neap tide.

5). Wave

Since the lagoon is isolated from the open sea, its sea condition is usually very calm. Observed highest wave in the lagoon during the survey period was about 0.8 m when the wind speed was 5 - 10 m/sec.

6). Water quality

Surveys of water quality were carried out on 29 March and 4 and 14 April. Transparency was determined by Secchi disc and sea water sample was taken by Kitahara's water sampler from surface layer (0.5 m deep) and bottom layer (1.0 m above the bottom) at each survey point. Salinity was determined by salinometer by Mr. Thomas Cherien at Khor Fakkan Fisheries Laboratory, dissolved oxygen content (DO) by Chemet DO meter (Chemetrics Inc., U.S.A.), and pH by Walpole colorimeter.

The results of surveys are shown in Fig. 6, A-E.

Transparency is higher at near the western opening than at the inner part of the lagoon. Transparency was lowered considerably by the suspending sand particles when the sea condition was rough.

Water temperature increased rapidly during the survey period from 19.9 - 21.2°C on 29 March and 21.8 - 23.8°C on 4 April to 25.2 - 27.1°C on 14 April. No significant difference of water temperature was observed horizontally and vertically in the lagoon.

Salinity ranged between 39.179‰ and 41.069‰. Salinity was higher at the inner part of the lagoon than near the western opening. Near the western opening of the lagoon, salinity was higher in the bottom layer than in the surface layer. At the inner part of the lagoon, however,

salinity sometimes became higher in the surface layer than in the bottom layer. The higher salinity recorded at the inner part of the lagoon might be the result of rapid evaporation.

DO ranged between 6 and 11 mg/ℓ and was in the saturation condition at all survey points in the lagoon.

pH was almost constant at 8.4 - 8.6 throughout the lagoon during the survey period.

7) Plankton

Qualitative surveys of plankton in the lagoon were carried out on 29 March and 14 April and a quantitative survey on 3 April. Qualitative survey was made by collecting plankton by a plankton net (mesh size 94μ) which was pulled horizontally just under the water surface. Quantitative survey was made by collecting about 1 ℓ of sea water by a bottle and counting the number of plankton contained in it.

Copepoda and a diatom, Rhizosolenia, were most abundant at the most of survey points on 29 March followed by nauplius of crustacea, Noctiluca and Sagittidae as shown in Table 2. On 14 April, copepoda was most abundant at all survey points followed by nauplius of crustacea, Noctiluca, Sagittidae, Gymnostomatida and Appendicularia (Table 3). Mysis larva of macrura which was rare on 29 March was observed more abundantly on 14 April.

Diatoms, crustacean larvae and Ceratium were the main plankton abserved in the quantitative survey. The number of the plankton was about 200 inds./ℓ at all survey points (Table 4).

8) Vegetation

Fig. 7 shows the distribution of vegetation in the lagoon observed in the survey period. Plants most commonly observed in the lagoon were Enteromorpha (green alga), Halodule uninervis (eel glass) and Avicennia marina (mangrove).

Enteromorpha was observed as patches on sand bottom at the shallow area. Halodule uninervis was most widely distributed at the shallow area in the lagoon. This plant was growing from the lower intertidal zone to the area as deep as 1 - 2 m at the low tide. Biomass of Halodule uninervis was 800 g/m^2 at Sts. 4s and 5s.

Avicennia marina was growing thickly on Bedwed Is. and Homeidhi Is. and some extent on Harmallah Is. Shoots of the plant were observed on Chaebe Is. and southern coast of the lagoon.

9) Benthic animals

Benthic fauna was surveyed at the deep area (Sts.1, 2, 3 and 5) of the

lagoon on 29 March and 14 April and at shallow Halodule area (Sts. 4s & 5s) on 16 April. At the deep area, benthic animals were collected by scooping bottom deposits using an Ekman-Berge bottom sampler (14.6 x 14.6 cm in mouth size) and then sieving the deposits through a sieve of 1 mm in mesh size. At the Halodule area of the intertidal zone four scoopings were made with a scoop cup of 8 cm in diameter to the depth of 5.5 cm in stead of an Ekman-Berge sampling.

Kinds and numbers of benthic animals collected at each survey point are shown in Table 5.

Pelecypoda, Polychaeta, Amphipoda, Paguridae, Cerithum and Gastropoda were relatively abundant at deep area. St. 5 (east of the reclaimed area) was richest in benthic animals both in quantity and in number of species among the deep area. This might be due to rich supply of organic matters from neighbouring Halodule area.

At Halodule area, a gastropoda, Cerithum was most abundant followed by Polychaeta.

Coral patches are scattered in the lagoon as shown in Fig. 7. The most extensive coral area in the lagoon was observed in Khor Al Midar. Alive coral patches were mainly observed in the zone between lowest low tide line and the line 1.5 m deeper than it.

10). Fishes

Fishes observed in the lagoon and at the fish market of Umm Al Quwain during the survey were listed in Table 6. Those fishes which were caught outside the lagoon were not included in the list, even if they were found in the fish market.

About 70 species were observed and 50 of them were more or less of economic values.

11) Animals of economic value other than fish

Squids and blue crabs were often found in the lagoon and at the fish market of Umm Al Quwain. Squids were observed at shallow places of the lagoon and were sought by children as good game fish. People in Umm Al Quwain eat this animal, which is rare habit in the Middle East.

Sea turtles were occasionally observed in the laggon . A fisherman informed us that sea turtles used to migrate in the lagoon for spawning in the past.

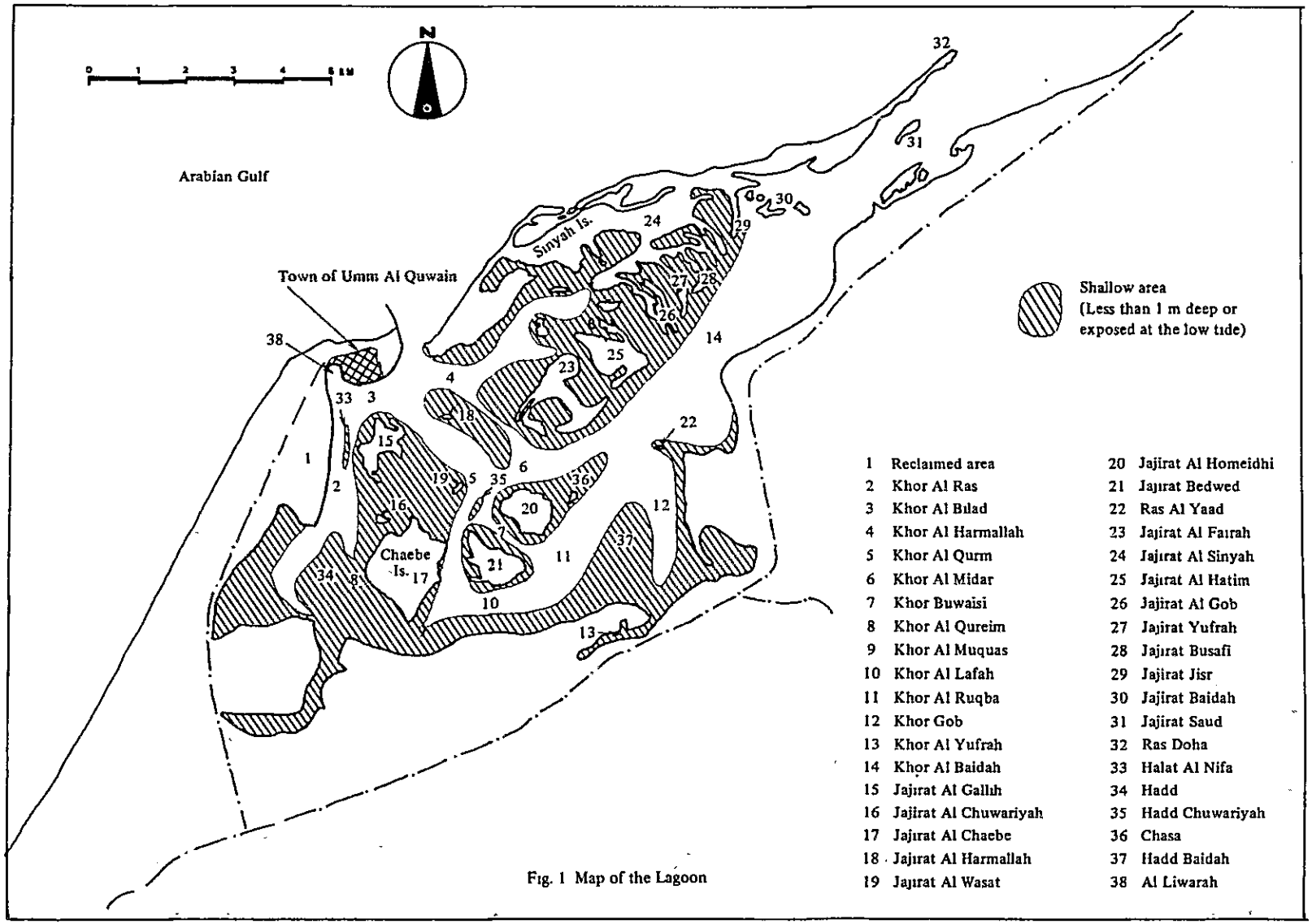


Fig. 1 Map of the Lagoon

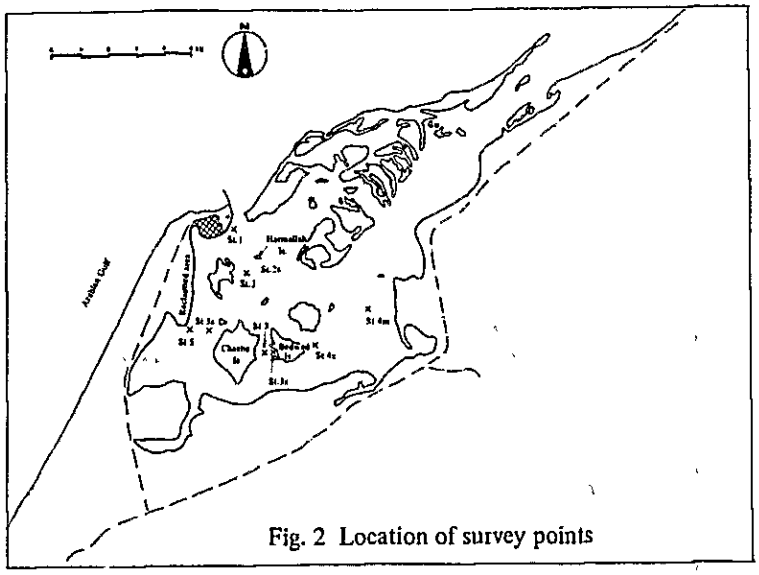


Fig. 2 Location of survey points

Table 1 Survey items and survey points

survey point / survey item	cannel area					shallow area				
	St.1	St.2	St.3	St.4	St.5	St.2s	St.3s	St.4s	St.4m	St.5s
Bottom quality			○		○	○	○	○	○	○
Tidal water level			○							
Water current	○	○	○	○	○					
Water quality	○	○	○	○	○					
Plankton	○	○	○	○	○					
Benthic animal	○	○	○	○	○			○		○

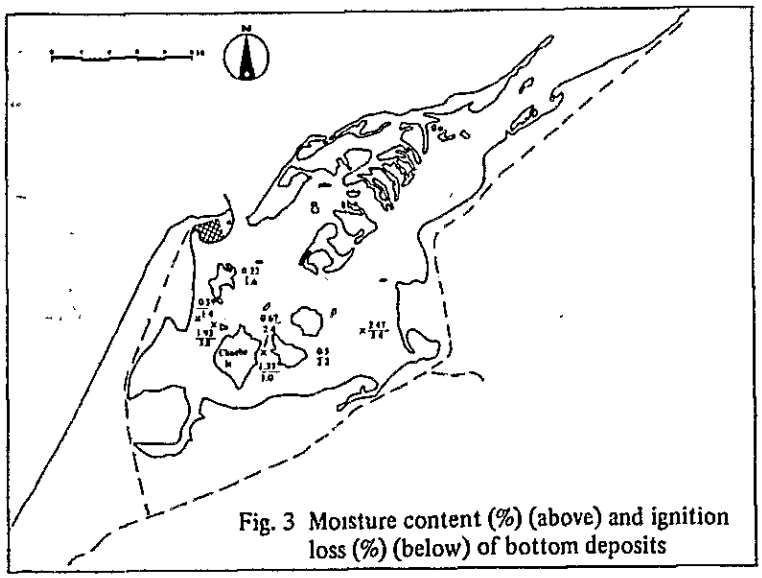


Fig. 3 Moisture content (%) (above) and ignition loss (%) (below) of bottom deposits

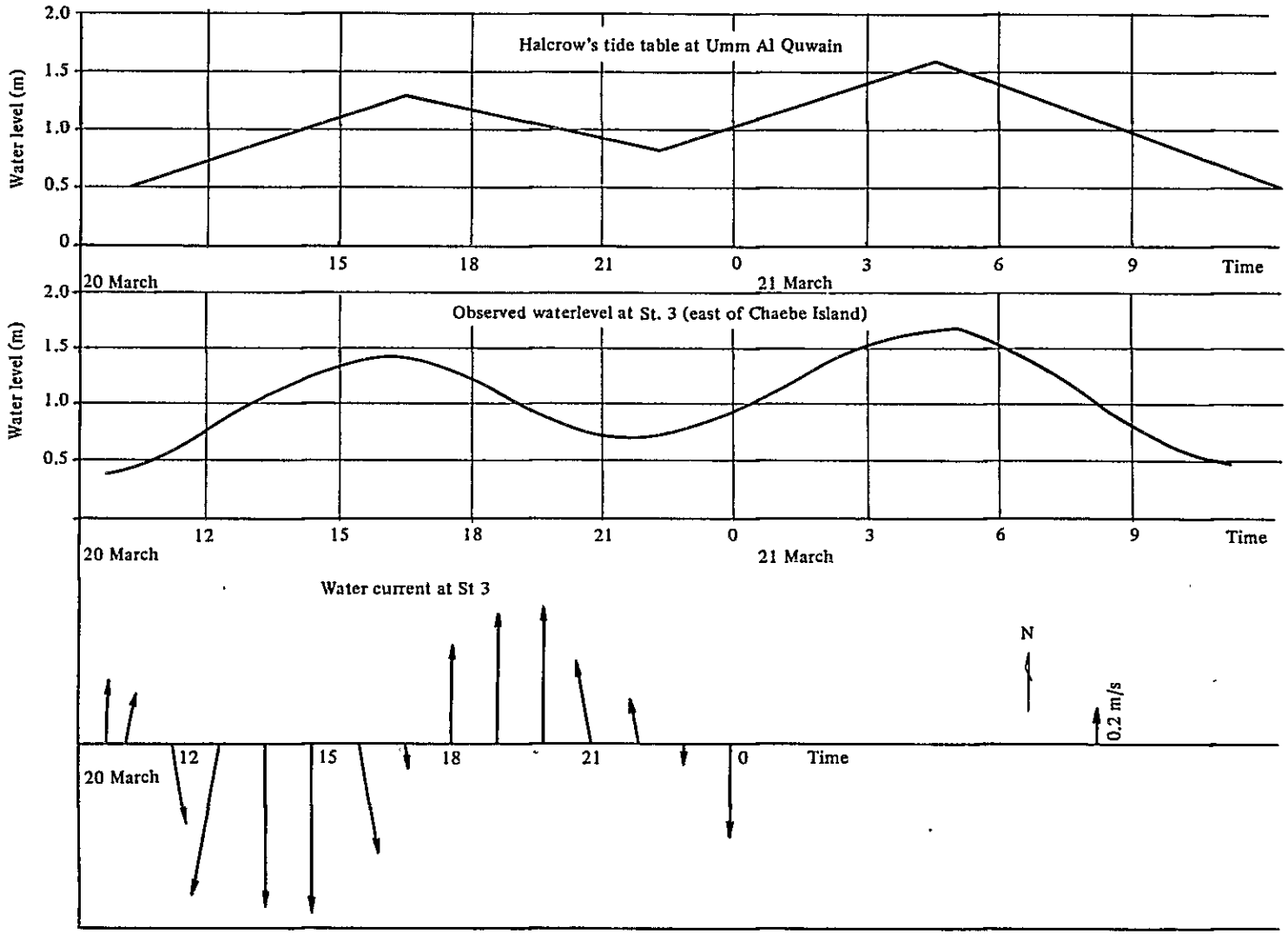


Fig. 4 Change of water level and water current measured at St. 3 on 20 and 21 March

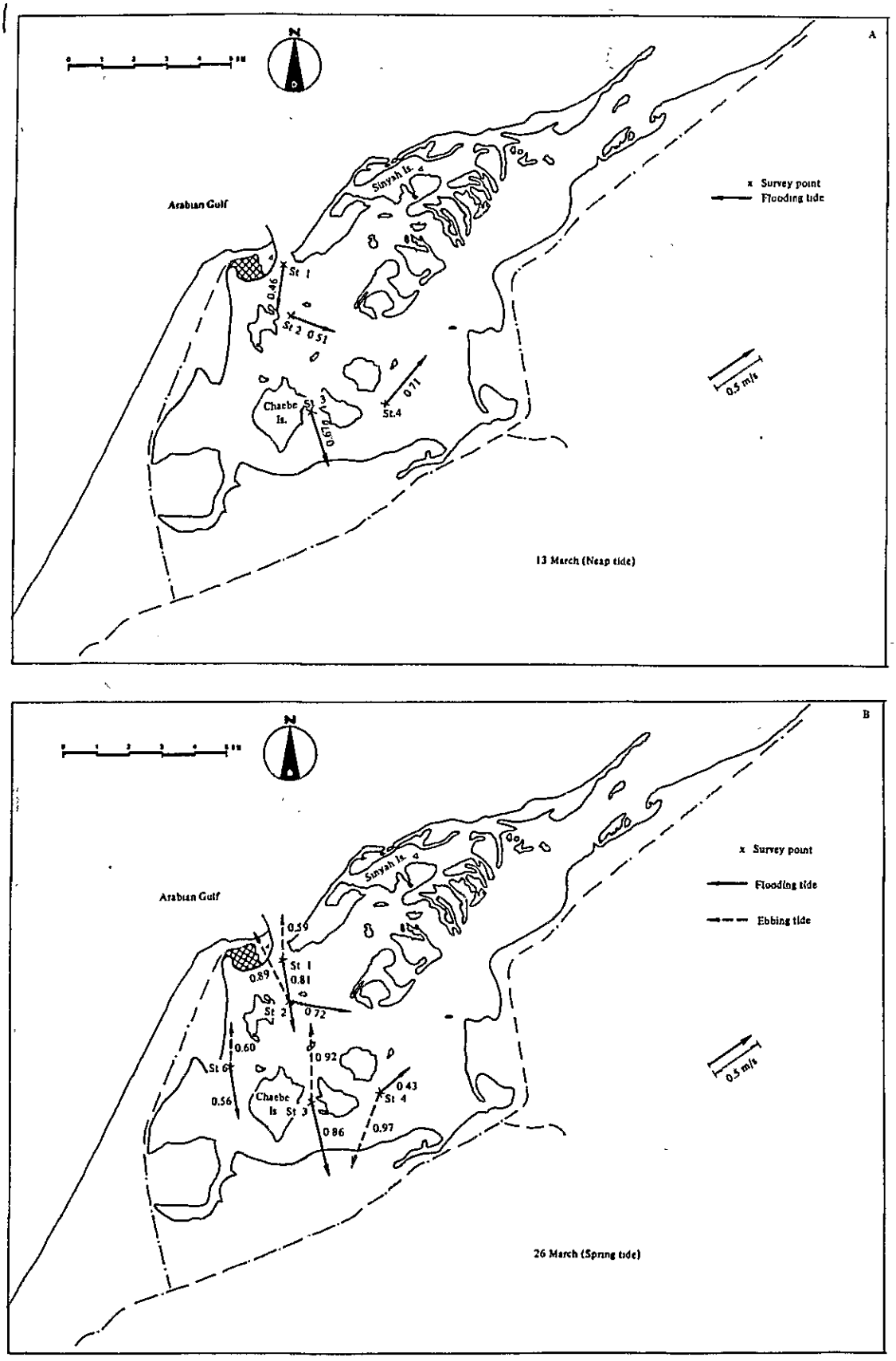
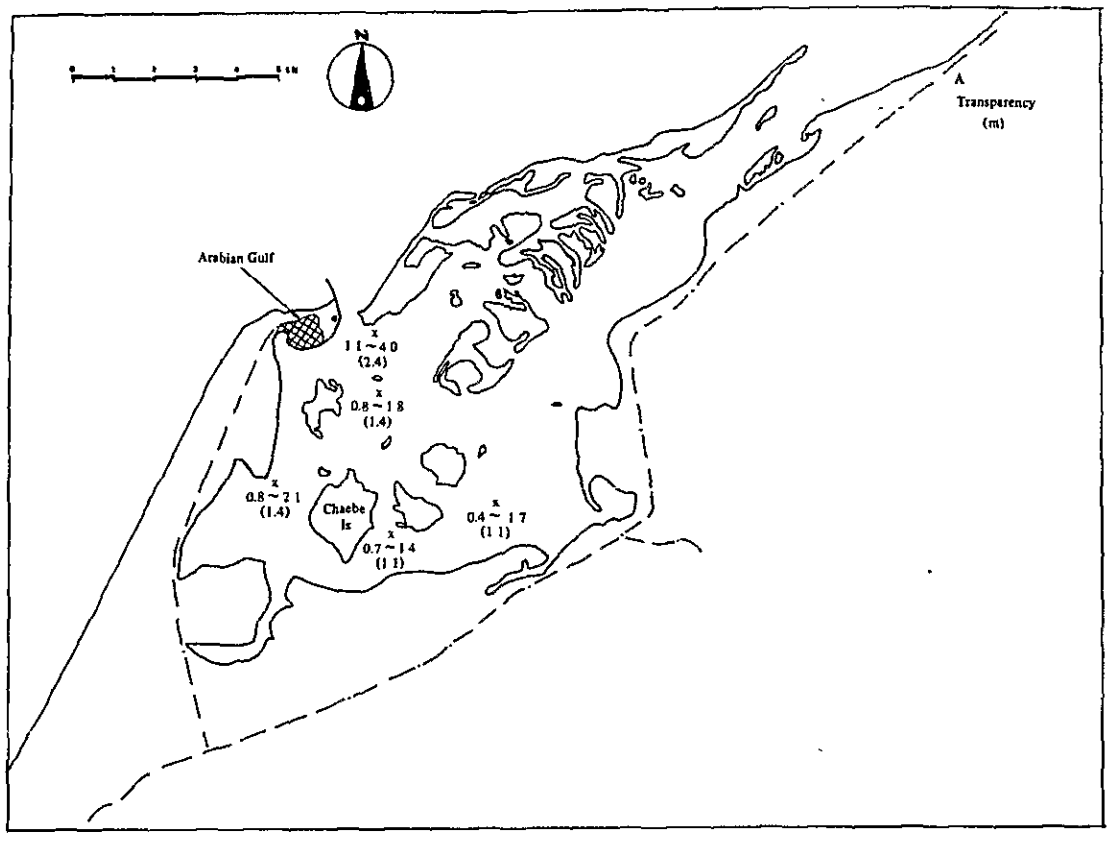


Fig. 5 Water current in the lagoon



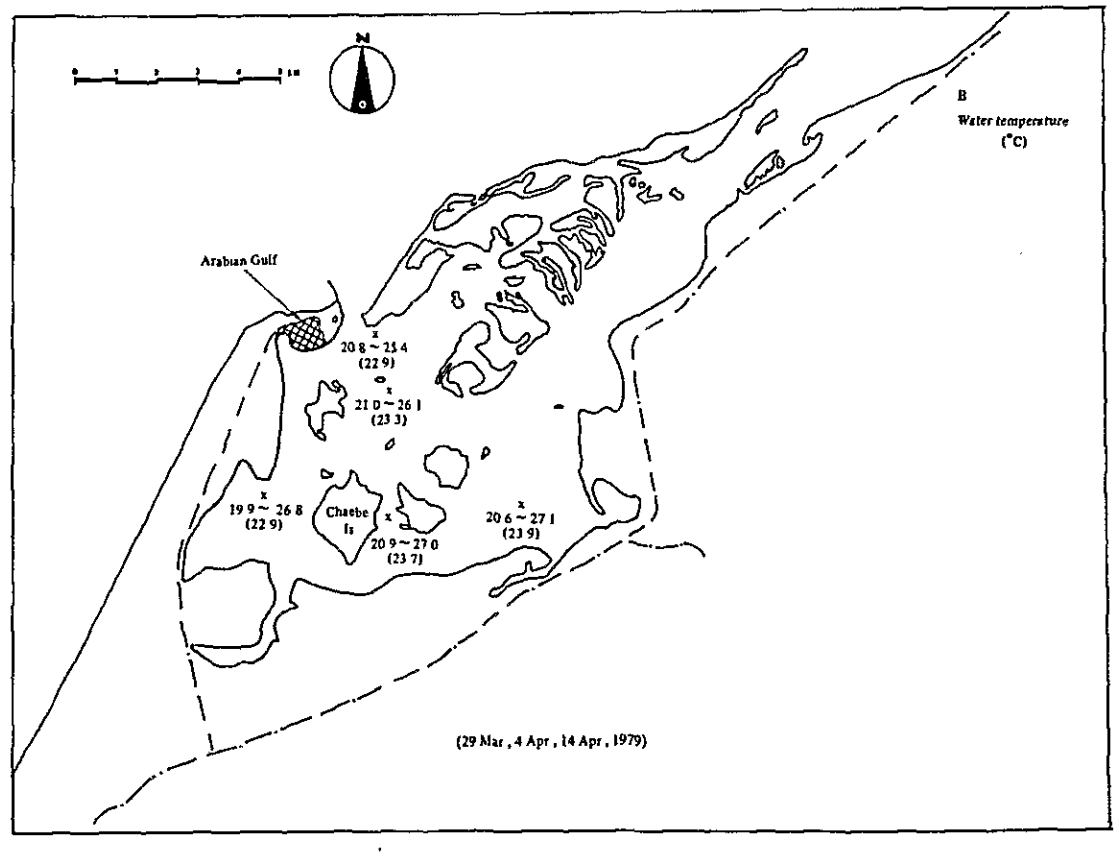


Fig. 6 Water quality in the lagoon.
Figure in parentheses is average.

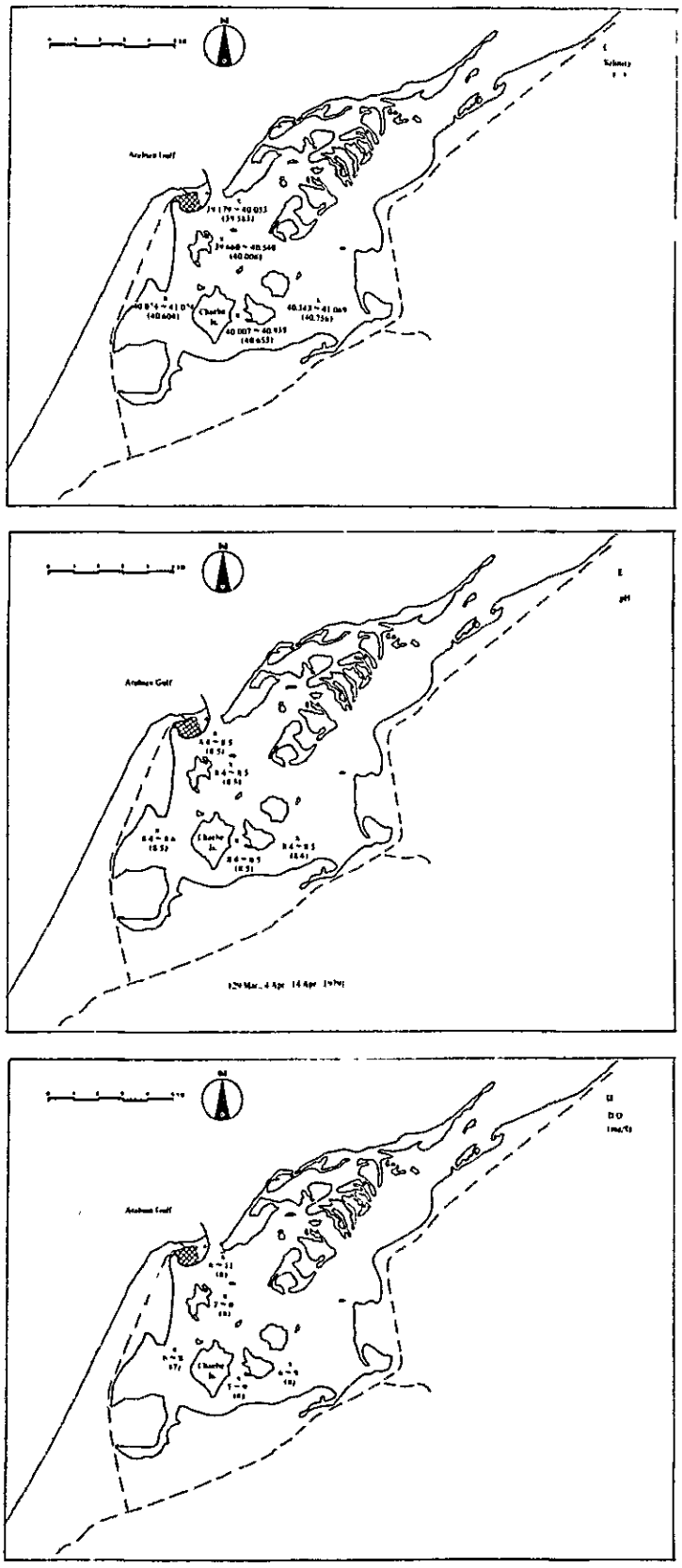


Fig. 6 Water quality in the lagoon. (continued)

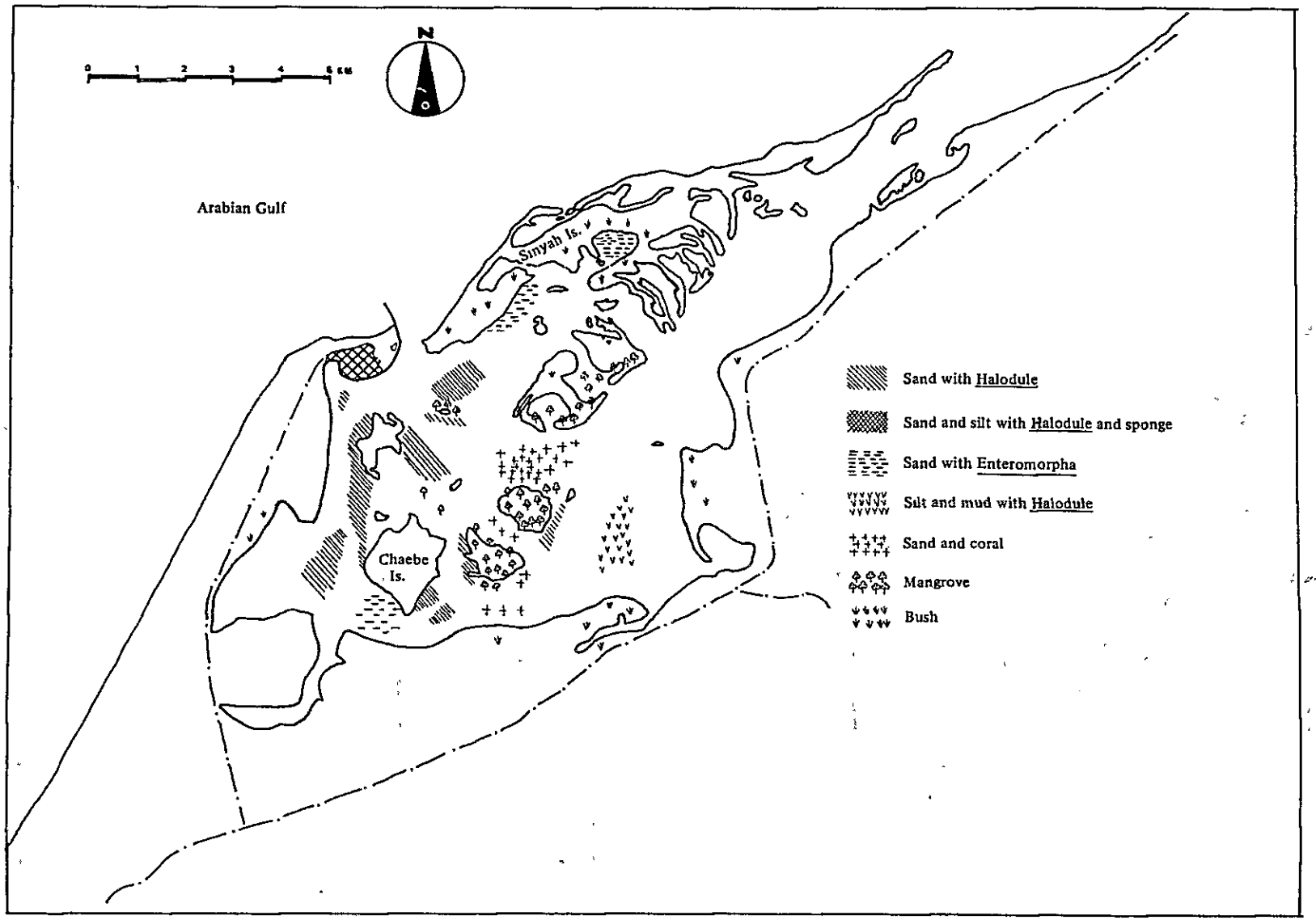


Fig. 7 Vegetation and bottom condition of the lagoon

Table 2. Relative abundance of plankton on 29 March.

Kind \ Station	St.1	St.2	St.3	St.4	St.5
BACILLARIOPHYTA					
genus Rhizosolenia	+++	+++	++	++	++
genus Pleurosigma	+	+		+	
PROTOZOA					
genus Noctiluca	++	++	+	+	+
genus Peridinium	+	+			
genus Ceratium	+	+	+		+
order Foraminifera	+	+	+	+	+
ANNELIDA					
Larvae of Polychaeta			+	+	
CHAETOGNATHA					
family Sagittidae	+	+	+	++	++
ARTHROPODA					
order Cladocera	+				
subclass Copepoda	+++	+++	+++	+++	+++
order Amphipoda	+				
genus Lucifer		+	+		+
Nauplius larvae of Crustacea	++	++	+	+	+
Mysis larvae of Macrura				+	
MOLLUSCA					
Advanced larvae of Gastropoda			+	+	+
Umbo Stage larvae of Pelecypoda	+	+	++	++	+
PROTOCHORDATA					
Larvae of Branchiostomidae		+			+
VERTEBRATA					
Eggs of fish	+	+			+
Larvae of fish		+			+

Table 3. Relative abundance of plankton on 14 April

Kind \ Station	St.1	St.2	St.3	St.4	St.5
BACILLARIOPHYTA					
genus Rhizosolenia	+				+
PROTOZOA					
genus Noctiluca	++	++	++		+
genus Ceratium	+	+	+		+
order Gymnostomatida	++	+	+	+	++
order Foraminifera	+	+	+	+	+
order Radiolaria	+	+			
COELENTERATA					
order Hydroida	+			+	+
ANNELIDA					
order Polychaeta	+		+		
Larvae of Polychaeta	+				
CHAETOGNATHA					
family Sagittidae	+	+	++	++	+
ARTHROPODA					
order Ostracoda			+		
suborder Copepoda	+++	+++	+++	+++	+++
Nauplius lervae of Crustacea	++	++	++	++	+++
Zoea larvae of Crustacea	+				
Mysis larvae of Macrura	++	+	++	++	+
MOLLUSCA					
Advanced larvae of Gastropoda			+		
Umbo stage larvae of Pelecypoda		+	+	+	
PROTOCHORDATA					
order Appendicularia	+++	+++	+	+	+
VERTEBRATA					
Eggs of fish	+	+			
Larvae of fish	+				

Table 4. Density of plankton in the lagoon (Inds./ℓ)

	St.1	St.2	St.3	St.4	St.5
BACILLARIOPHYTA					
order Centrales (except Rhizosolenia)	30	85	126		55
genus Rhizosolenia	30	11			
PROTOZOA					
genus Peridinium	30			24	
genus Ceratium	60	21	42		
ARTHROPODA					
suborder Copepoda					18
Larvae of Crustacea	60	21		48	36
MOLLUSCA					
Veliger larvae				24	
Unknown animal	30	53	84	73	37
Total	240	191	252	169	146

(3 Apr. 1979)

Table 5. Number of benthic animals. (Figure in parentheses shows number of species)

Date			29 March 1979				14 April 1979				16 April 1979	
Kind \ Station			St.1	St.2	St.3	St.5	St.2	St.3	St.4	St.5	St.4s	St.5s
ANNELIDA	class	Polychaeta		12(≧6)	1	6(≧4)		7(≧3)	4(4)	14(≧7)	7(≧5)	14(≧3)
ARTHROPODA	suborder	Balanomorpha						1				
"	family	Tilidae										1
"	order	Amphipoda	1				1	2(≧1)		15(≧1)		
"	order	Mysidacea								1		
"	suborder	Macrura(Encyphidea)								1		
"	family	Paguridae				8(≧1)				3(≧1)		4(≧1)
"	family	Leucosiidae	3(1)							2(1)		
"	family	Portunidae										1
MOLLUSCA	class	Polyplacophora		1								
"	genus	Cerithum				10(≧1)				2(1)	72(≧1)	20(≧1)
"	genus	Olivella								1		
"	order	Gastropoda(4 species)		2		6				3		1
"	Young form of Gastropoda		2(1)	1	1							
"	genus	Mytilus		1		1						
"	Young form of Pelecypoda		2(≧1)			2(≧1)	1		1	42(≧3)	2(1)	2(2)
Area of sampling (cm^2)			213	213	213	213	213	213	213	213	201	201
Depth of sampling (cm)											0~5.5	0~5.5
Character of deposit			Sand	Gravel	Sand, gravel	Sand, dead Halodule	Sand	Gravel	Sand	Sand, dead Halodule	Sand, Halo-dule	Sand, Halo-dule

Table 6. List of fishes in UAQ lagoon

Family	Species	Location
Charcharinidae	Several species	Fish market
Rhynchobatidae	One species	"
Torpedinidae	"	Discarded at the beach
Dasyatidae	Several species	"
Myliobatidae	"	"
Clupeidae	Nematalosa nasus	Fish market
	Several other species	Fish market, coastal area
Chirocentridae	Chirocentrus dorab	Fish market
Chanidae	Chanos chanos	"
Ariidae	Arius thalossimus	"
Batrachoididae	Batrachus grunniens	Under stones at tidal zone
Exocoetidae	Hemiramphus magrinatus	Fish market
Belonidae	Ablennes hians	"
	Tylosurus leiurus	"
Cyprinodontidae	Aphanius dispar	Shallow sand beach
Atherinidae	Allanetta forskali	Coastal area
Platycephalidae	Platycephalus indicus	Fish market
Serranidae	Epinephelus tauvina	"
Theraponidae	Several species	Everywhere in the lagoon
Sillagiridae	Sillago sihama	Shallow area of sand bottom
Rachycentridae	Rachycentron canadus	Fish market
Echeneidae	Echeneis naucrates	Discarded at the beach
Carangidae	Caranx malabarius	Fish market
	Caranx speciosus	"
	Chorionemus lysan	"
	Several other species	"
Lutjanidae	Lutjanus coccineus	"
	Lutjanus fulviflamma	"
	Lutjanus kasmira	"
	Several other species	"
Nemipteridae	Nemipterus tolu	"
Gerridae	Gerres oyena	"
Pomadasyidae	Plectorhynchus scholaf	"

Pomadasyidae	Plectorhynchus cinctus	Fish market
	Pomadasys argenteus	"
	Scolopis phaeops	"
	Scolopis bimaculatus	"
	Several other species	"
Lethrinidae	Lethrinus nebulosus	"
	Lethrinus lentjan	"
	Two other species	"
Sparidae	Acanthopagrus berda	"
	Acanthopagrus bifasciatus	"
	Agyrops spinifer	"
	Diplodus noct	"
	Crenidens crenidens	"
	Two other species	"
Mullidae	Mulloidichthys auriflamma	"
	One other species	"
Ephippidae	Drepame longimana	"
Chaetodontidae	Chaetodon obscurus	"
	Pomacanthus maculosus	"
Mugilidae	Liza macrolepis	"
	Liza oligolepis	"
	One other species	"
Sphyraenidae	Sphyraena jello	"
Caridae	Two species	"
Gobiidae	Several species	Shallow bottom
Blennidae	"	"
Siganidae	Siganus javus	Fish market
	Siganus oramin	"
Bottidae	Several species	"
Soleidae	Several species	"
Triacanthidae	Triacanthus biaculeatus	Discarded at the beach
Tetraodontidae	Several species	"

2. DISTRIBUTION OF LARVAE AND JUVENILES OF FISHES AND SHRIMPS IN THE LAGOON.

Preliminary surveys were made in the lagoon on 10, 11 and 18, March to find places abundant with larvae, juveniles of fishes and shrimps and to find suitable type of net to collect them (Fig. 8).

A small net as shown in Fig. 10 was found to be efficient for the purpose. It was also found that larvae and juveniles were most abundantly found in the areas of 20-70 cm deep at the low tide and with Halodule vegetation on the bottom.

Surveys on 2, 6 and 17 April were, therefore, carried out only at Halodule areas shown in Fig. 8.

Fig. 9 shows the relative quantity of juvenile shrimp of Penaeus semisulcatus in the Halodule areas in the lagoon expressed by the number of juveniles collected per 25 m-draging of the above mentioned net. The number was smallest at Harmallah Is. (Pt. 10) where only 2 juveniles were collected per 25m-dragging. The largest number of juvenile shrimps was collected at south eastern shore of Homeizi Is. (Pt. 15) where 55 shrimps were collected per 25m-dragging. Shallow Halodule area in Khor Ras (Pt. 9) was also abundant with shrimp juveniles. The body length of collected shrimps ranged between 1.0 cm and 4.6 cm. There was a tendency that shrimps collected at places abundant in number such as Sts. 9, 15, 16, and 17 were smaller in size than those collected at places fewer in number such as Pts. 10, 11 and 12. Water temperature which fluctuated between 22.1°C and 27.0°C did not show any relation to the abundance of shrimp juvenile.

No juvenile of rabbitfish, Siganus oramin, was collected until 17 April except the one juvenile of 2.2 cm in fork length which was caught at south eastern shore of Homeizi Is. (pt.17) on 7 April. On 6 May, 6 juveniles of 2.5-3.0 cm in fork length were caught at Harmallah Is. where large number of juvenles were caught on 10 June last year. It can be said, therefore, that juveniles of rabbitfish occur in the lagoon in May and June.

Many shoals of juveniles of Mullet, Liza macrolepis, were observed and easily collected by the net at shallow areas of sand bottom. Also many mullets of 1.5 cm - 2.2 cm in fork length were collected at Holodule area of Harmallah Is. (Pt.2) and some of the same size at Western shore of Bedwed Is. (Pt. 6).

Large number of juveniles of sparid fish, Crenidens orenidens, of 1.0 cm - 4.8 cm in fork length were collected at all Halodule areas in the lagoon. Juveniles of clupeid fish were collected in large number at eastern shore of Chaebe Is. (Pt. 6) and Halodule area of Khor Ras (Pt. 9). Gobiidae, Theraponidae, Caridean shrimps and amphipods were always collected at Halodule area in certain numbers. Juvenile shrimp of Metapenaeus spp. were collected at Halodule areas and sand bottom areas in small number. Big shoals of Aphaneus dispar were observed at tidal zone of mangrove areas, e.i. Bedwed and Homeizi Ils., and could be netted in large number. Juvenile fish of Lutjanidae, Gerridae, Sparidae, Syngnathidae, Platycephalidae , Bothidae, Blennidae, Coetidae and Lethrinidae and Sergestidae shrimp were also collected often at Halodule areas in the lagoon.

As the result of the survey, it can be said that juveniles of shrimp, rabbitfish and mullet can be collected at the order of thousand in number as natural seeds for aquaculture. The quantity of the natural seeds, however, might not be large enough to support big scale aquaculture. Artificial production of seeds, therefore, will be essential for aquaculture development in UAE.

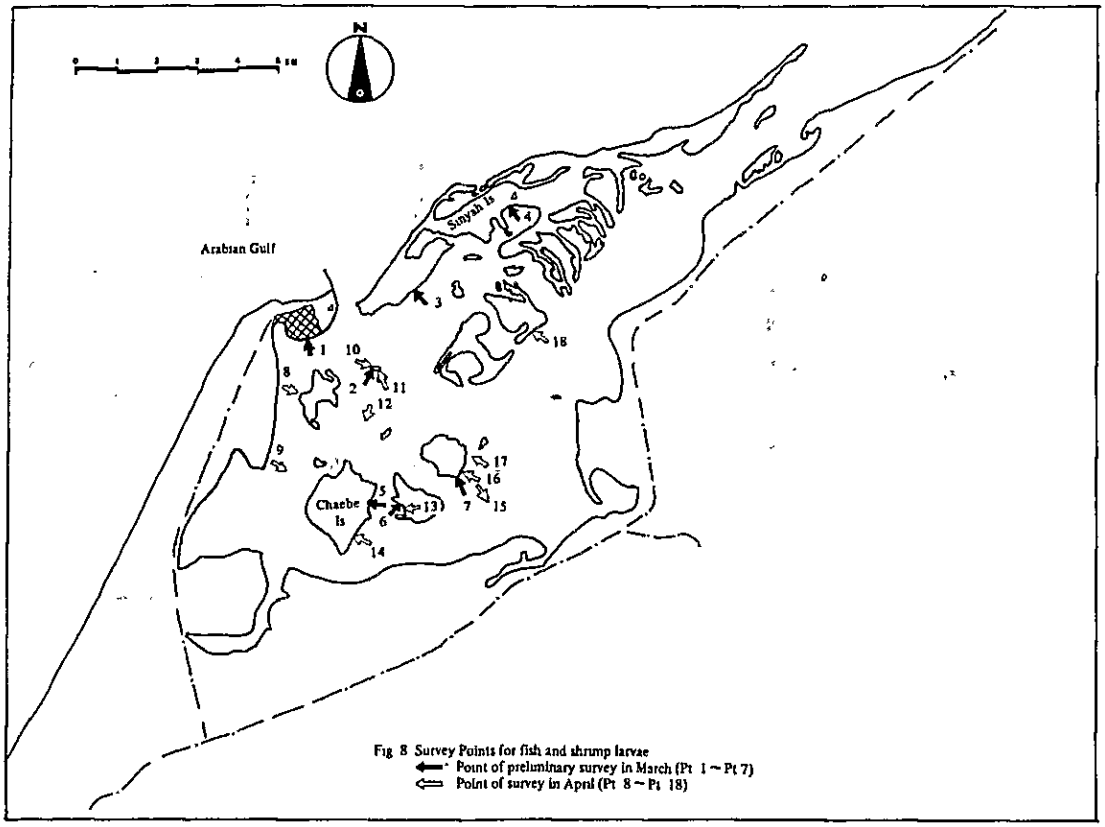


Fig 8 Survey Points for fish and shrump larvae
⟸ Point of preliminary survey in March (Pt 1 ~ Pt 7)
⟸ Point of survey in April (Pt 8 ~ Pt 18)

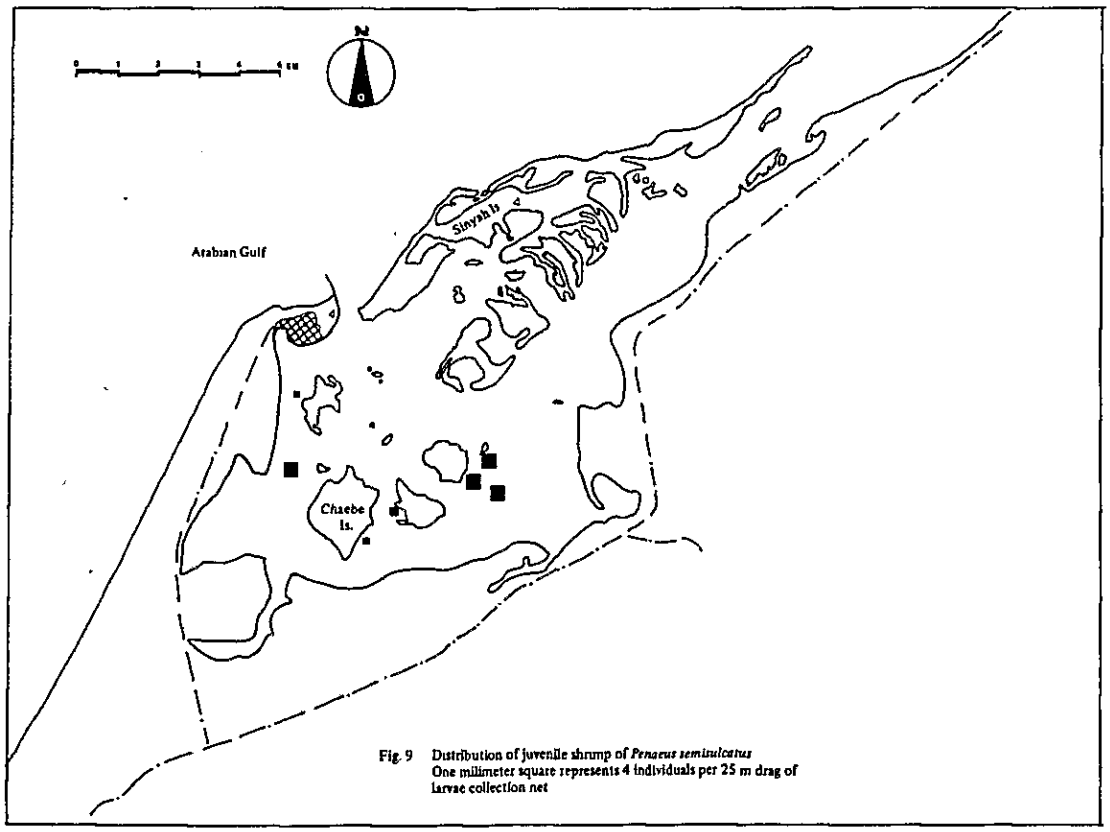
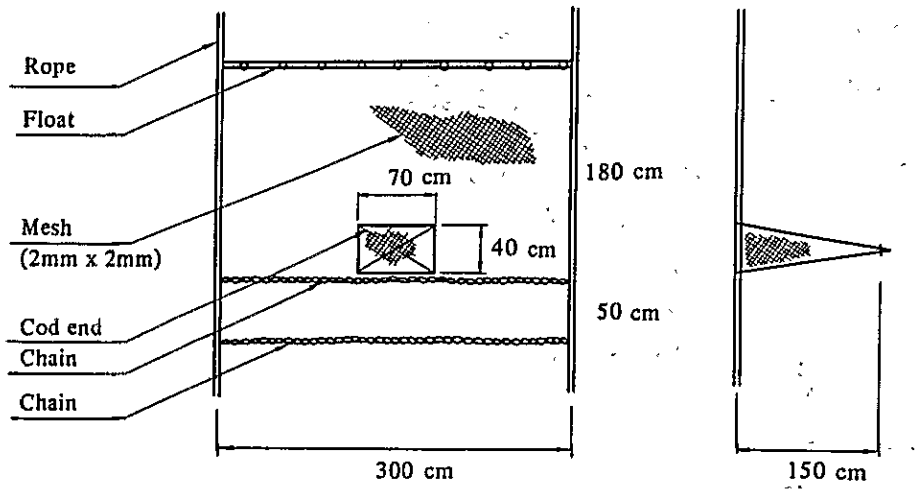
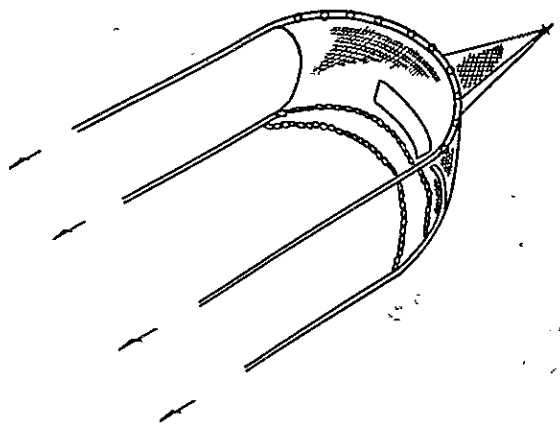


Fig. 9 Distribution of juvenile shrump of *Penaeus semisulcatus*
One milimeter square represents 4 individuals per 25 m drag of larvae collection net



Front view

Lateral view



Net in operation

Fig. 10 Larvae collection net

3. FISHERY BIOLOGICAL SURVEY ON FISHES AND SHRIMP.

Rabbitfish (Siganus oramin). Fresh rabbitfish just after landed were bought as samples at Umm Al Quwain fish market on 15 and 22 March and 4 and 12 April. The amount and unit price of samples were shown in Table 7. The unit price of rabbitfish fluctuated between Dh. 10 and Dh. 18 per kg. Fork length distribution of each sample is shown in Fig. 11 and the relationship between body weight and body length for all samples in Fig. 12. The smallest individual among all samples was 14.6 cm, 42 g and biggest was 35.3 cm, 770g.

Stomach and intestine contents were dominated by a green algae, Enteromorpha. Halodule and gastropod shells were occasionally found in alimentary canal of the fish. The domination of Enteromorpha is explained by the fact that fishermen always put this algae in traps (gargoor) as bait to catch the fish.

In the sample bought on 5 March, 44% of males milted by a gentle press at their abdormen. Females in the sample, on the contrary, were at a stage far from gonadal maturation. Gonad index (= gonad weight x 1000/ body weight) (Fig. 13) was 74 for male and 45 for female in average. In the sample of 22 March, all males were fully matured and 60% of females were at maturing stages. Gonad index was 94 for male and 46 for female in average. All males were fully matured in the sample of 5 April. Almost all females in the sample of the day released eggs by a gentle press at abdormen. The eggs were, however, opaque in color and small in size and thus were not fully matured. Gonad index reached at highest value in this sample being 156 for male and 125 for female in average. In the sample of 12 April, almost all males milted but the size of testis had reduced considerably comparing to those of previous samples. Among females, 70% were spent and the rest were at maturing stage. The gonad index dropped sharply to 31 for male and 26 for female in average.

Considering the changes in maturation condition of gonad mentioned above, it can be said that rabbitfish spawns in rather short period at the beginning of April. Matured male are available from the middle of March to the beginning of April. Fully matured female, on the contrary, is obtainable only in very short period at the beginning of April. These facts must be taken into consideration when artificial seedling production is planned.

Mullet (Liza macrolepis) Mullets were landed at Umm Al Quwain fish market in very small quantity during the survey period. Only seven individuals were bought as a sample on 5 April. Unit price was Dh. 10 per kg. Fork length ranged from 19.0 cm to 25.6 cm and body weight from 89 g to 225 g. Three individuals out of 7 were females. Only one female had maturing ovary and the rest had gonads far from maturation.

According to the Umm Al Quwain Fisheries Office, the peak season of mullet fishery is in September in the lagoon.

Shrimp (Penaeus semisulcatus) Fifty individuals of shrimp, Penaeus semisulcatus, which were caught in Abu Dhabi waters by small local trawlers were sampled at Abu Dhabi fish market in the end of March. All shrimps were small. Body length ranged from 5.5 cm to 11.8 cm and body weight from 2 g to 22 g. Only 32% of the sample were female. Three females had slightly developed ovaries and the rest of females had only very lean ovaries.

On 13 April, Abu Dhabi fish market was inspected. About 300 kg of Penaeus semisulcatus which were fished in Abu Dhabi waters were landed at the market. All of those shrimps were small in size and did not show any evidence of gonadal maturation. Beside P. semisulcatus, about 200 kg of big size shrimp, P. merguiensis, fished in Iranian waters were sold at the market.

Among those shrimps which are caught by trawlers belonged to Islamic Bank Fishing Co. in Dubai were dominated by a small size shrimp, Metapenaeopsis sp. and no P. semisulcatus was found.

A small trawler which started operation in Umm Al Quwain lagoon recently also did not catch P. semisulcatus.

It will not be possible, therefore, to obtain spawners of P. semisulcatus in the waters of northern Emirates.

The unit price of small size shrimp and big size shrimp were Dr. 15 and Dh. 20 per kg respectively in Abu Dhabi fish market. The price, however, was said to widely fluctuate seasonally.

Table 7. Sample of rabbitfish, Siganus oramin bought at UAQ Fish Market

Date	No. of specimen		Total weight	Unit price (Dh/kg)
	Male	Female		
15 March	16	10	3.88	18
22 March	1	5	1.43	14
5 April	7	14	3.04	10
12 April	10	10	3.05	15

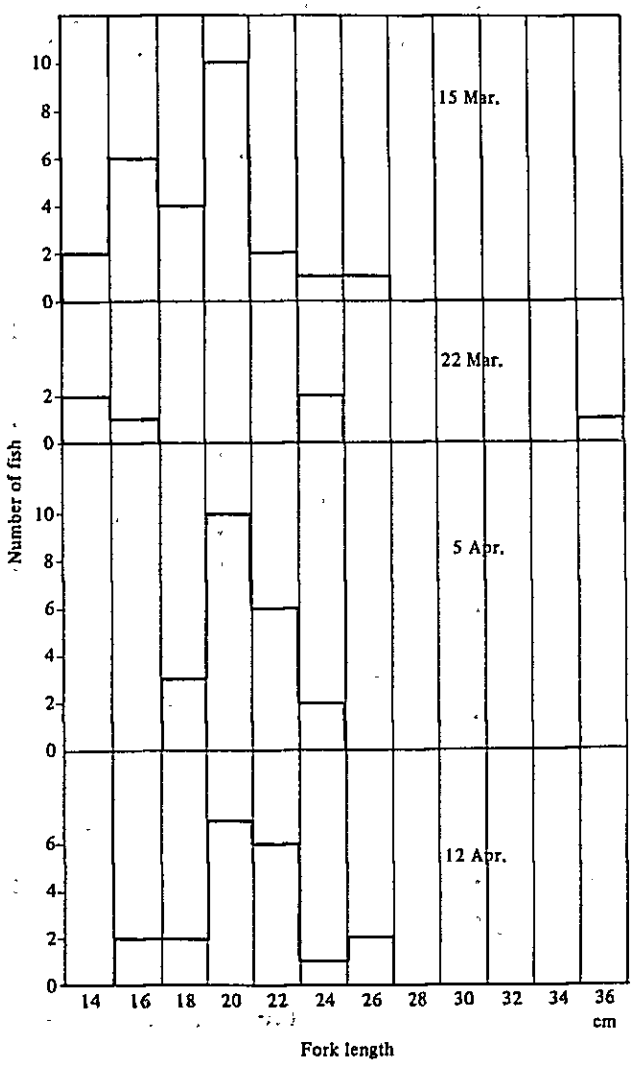


Fig. 11 Fork length of rabbitfish, *Siganus oramin*

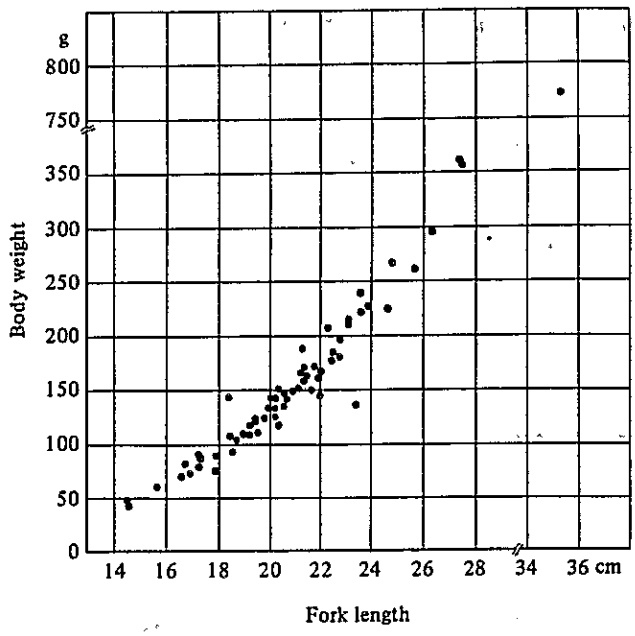


Fig. 12 Weight-length relationship of rabbitfish, *Siganus oramin.*

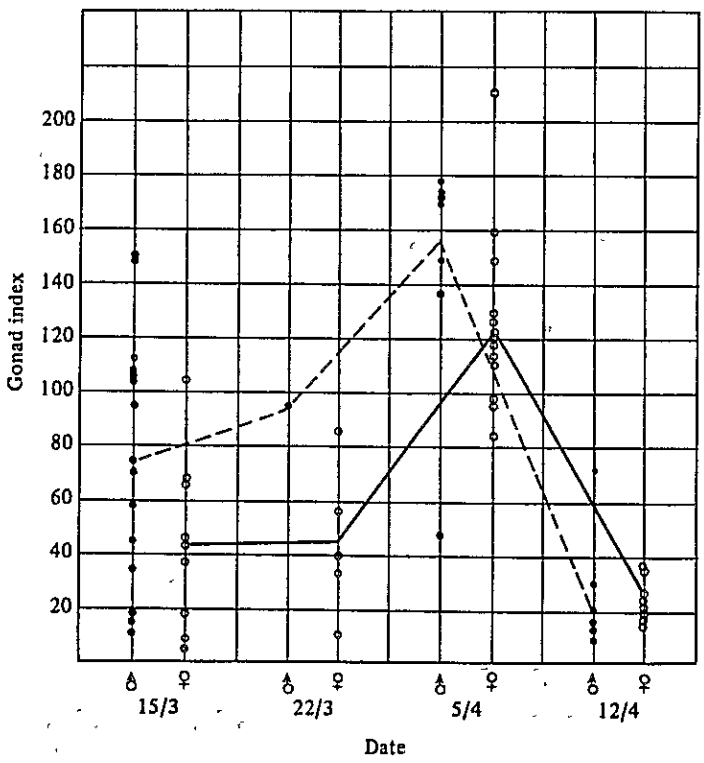


Fig. 13 Change of gonad index of rabbitfish, *Siganus oramin,* (•: male, ∘: female), Broken line and solid line show change of average value of the index for male and female respectively.

4. PRESENT CONDITION OF LOCAL FISHERIES IN UMM Al QUWAIN

There were about 70 fishing boats in Umm Al Quwain. Most of these boats were small size boats locally called 'Shu'ai'. 'Shu'ai' was about 8 m long and 2 m wide in average with pointed stem and transom stern. This type of boats was mainly employed for traps, gill net and beach seine fishing inside and outside the lagoon. There were some smaller boats called "Houri". 'Houri' was dug-out type boat of 5 m long and 1 m wide in average and manned by one or two persons. This type of boats was employed for trap, net trap, gill net and angling fishery mainly inside the lagoon. Both types of boats were powered by outboard engines. Beside these two types of boats, there were small number of boats of a larger type called 'Sambuk'. 'Sambuk' powered by a inboard engine was about 15 tons. This type of boats were engaged in trap and gill net fishing outside the lagoon. Recently one of these boats started trawling inside of the lagoon.

Number of fishermen in Umm Al Quwain was about 150. Sixty of them owned one or more fishing boats and the rest were employed by boat owners. Besides these fishermen of UAE nationals, there were about 100 expatriate fishing labourers of Indian or Pakistani nationality.

Fishing methods employed in Umm Al Quwain were beach seine (Āmura), gill net (Leeh), trap (gargoor) net trap (Skār), angling (Haddāk) and trawling (Kārab or Shabaka). Gill net and trap were more widely used outside the lagoon than inside except a kind of small traps for rabbitfish. Kinds of fish caught by each fishing method were as follows:

Beach seine: travelly, rabbitfish, scavenger, sardine.
Gill net : (inside the lagoon); mullet, milkfish.
(outside the lagoon); barracuda, spanish mackerel.
Trap : (inside the lagoon); rabbitfish, black porgy.
(outside the lagoon); grouper, snapper, scavenger.
Net trap : small scavenger, small snapper, black porgy, travelly.
Angling : black porgy, scavenger.
Trawling : black porgy, scavenger.

Among these fishing methods, the trap for rabbitfish was worth noticing. Since rabbitfish commanded the highest market price, trap fishing for this fish was most flourishing in the lagoon. The trap which looked like a large rattrap was made of steel wire and was hemispheric shape of 0.5 m in height and 1 m in diameter. A green alga, Enteromorpha, was put in the trap to attract rabbitfish. The trap was set on the bottom of rather

shallow areas in the lagoon and was lifted up periodically to take out fish trapped inside.

The catch was usually sold to fish brokers when landed. The brokers either sold the catch at Umm Al Quwain fish market or kept it in ice boxes for shipping to Dubai and Abu Dhabi market next morning. When fishermen did not agree to the price proposed by brokers, they sent the catch by themselves to Umm Al Quwain fish market or Dubai and Abu Dhabi fish markets. Some fish brokers in Umm Al Quwain imported fish from Oman and sold it at Abu Dhabi market.

The quantity of fish landed daily at Umm Al Quwain fish market was estimated to be about 1 ton in average. Fisheries office of Umm Al Quwain estimated the quantity of fish shipped to Dubai and Abu Dhabi markets as twice as much of that landed at Umm Al Quwain market. The annual catch at Umm Al Quwain was, therefore, estimated to be about 900 tons.

Nine fish retailers licensed by Umm Al Quwain municipality were working at the market.

VI. BASIC PLANNING FOR UAE MARICULTURE CENTER

1. OUTLINE OF UAE MARICULTURE CENTER PROJECT

1) Construction site

Southern part of reclaimed area at the western coast of Umm Al Quwain lagoon including intertidal zone and sea adjacent to it.

As to required area, attached map should be referred.

2) Purpose of the Center

i) Research and development of techniques for commercial mariculture in UAE.

ii) Training of manpower for mariculture in UAE.

iii) Extention work and technical service for commercial mariculture in UAE.

iv) Demonstration of commercial mariculture production.

3) Production target and Work Plan

Within five years commercial aquaculture techniques will be established to be ready for practice and the Center will be operating its proper works mentioned in the purpose of the Center. The production target and work plan in the Center will be summarized as follows:

Year	Work plan or Production target		
1981	Shrimp	2,500 Heads	(100 kg)
	Rabbitfish	2,000 Heads	(300 kg)
	Mullet	2,000 Heads	(400 kg)
1982	Shrimp	5,000 Heads	(200 kg)
	Rabbitfish	4,000 Heads	(600 kg)
	Mullet	4,000 Heads	(800 kg)
	Shrimp seed	250,000 Heads	
	Rabbitfish seed	50,000 Heads	
	Mullet seed	50,000 Heads	
1983	Shrimp	10,000 Heads	(400 kg)
	Rabbitfish	8,000 Heads	(1,200 kg)
	Mullet	8,000 Heads	(1,600 kg)
	Shrimp seed	500,000 Heads	
	Rabbitfish seed	100,000 Heads	
	Mullet seed	100,000 Heads	
1984 & 1985	Experiment to reduce production cost and establish techniques for commercial mariculture		
1986 & Later on	Guidance for commercial fish farmers, training of mariculture manpower, production of seed, development of new techniques or new mariculture species. Open aquarium		

4) Construction Plan

To implement the plans mentioned above, the following facilities should be constructed.

Year of Construction	Facility	Size and Structure
1980, 1981	Laboratory bldg.	910 m^2, RC 2 stories
"	Feed production bldg.	216 m^2, RC 1 story
"	Filtration bldg.	153 m^2, RC 1 story
"	Tank	200 ton (2), 200 m^2, RC
"	"	50 ton '5), 125 m^2, RC
"	"	8 ton (10), 80 m^2, RC
1980	Pond	2,500 m^2 (2), 5,000 m^2
"	Floating fish pen	3m x 3m x 2m (5)
"	Wharf	20 m x 3 m, Wooden
"	Slip way	20 m x 5 m, RC
1980, 1981	Paved road	12,000 m^2
"	Fence	450 m
"	Gate	2 places
"	Light, draining ditch etc.	
1983	Pond	2,500 m^2 (2)
"	Floating fish pen	3m x 3 m x 2 m (5)
1985	Aquarium	846 m^2, RC 2 stories
"	Dormitory	176 m^2, RC 1 story

5) Personnel Plan

To implement the plans mentioned in 3), the following personell will be neccessary each year.

Title & Speciality	Qualification	1981	1982	1983	1984	1985	1986
Director, Aquaculture	University graduate 15 years experience	1	1	1	1	1	1
Researcher, Aquaculture	University graduate 5 years experience	1	2	2	1	1	1
Researcher, Aquarium	University graduate 5 years experience						1
Researcher, Biology	University graduate	1	2	2	3	3	5
Assistant	High school graduate	1	3	3	5	5	7
Mechanic			1	1	1	1	2
Electrician		1	1	1	1	1	2
Clerk			1	1	1	1	2
Typist			1	1	1	1	2
Driver		1	1	1	1	1	2
Office boy			1	1	1	1	2
Watch man		1	1	1	1	1	1
Total		7	15	15	17	17	28

6) Budget Plan

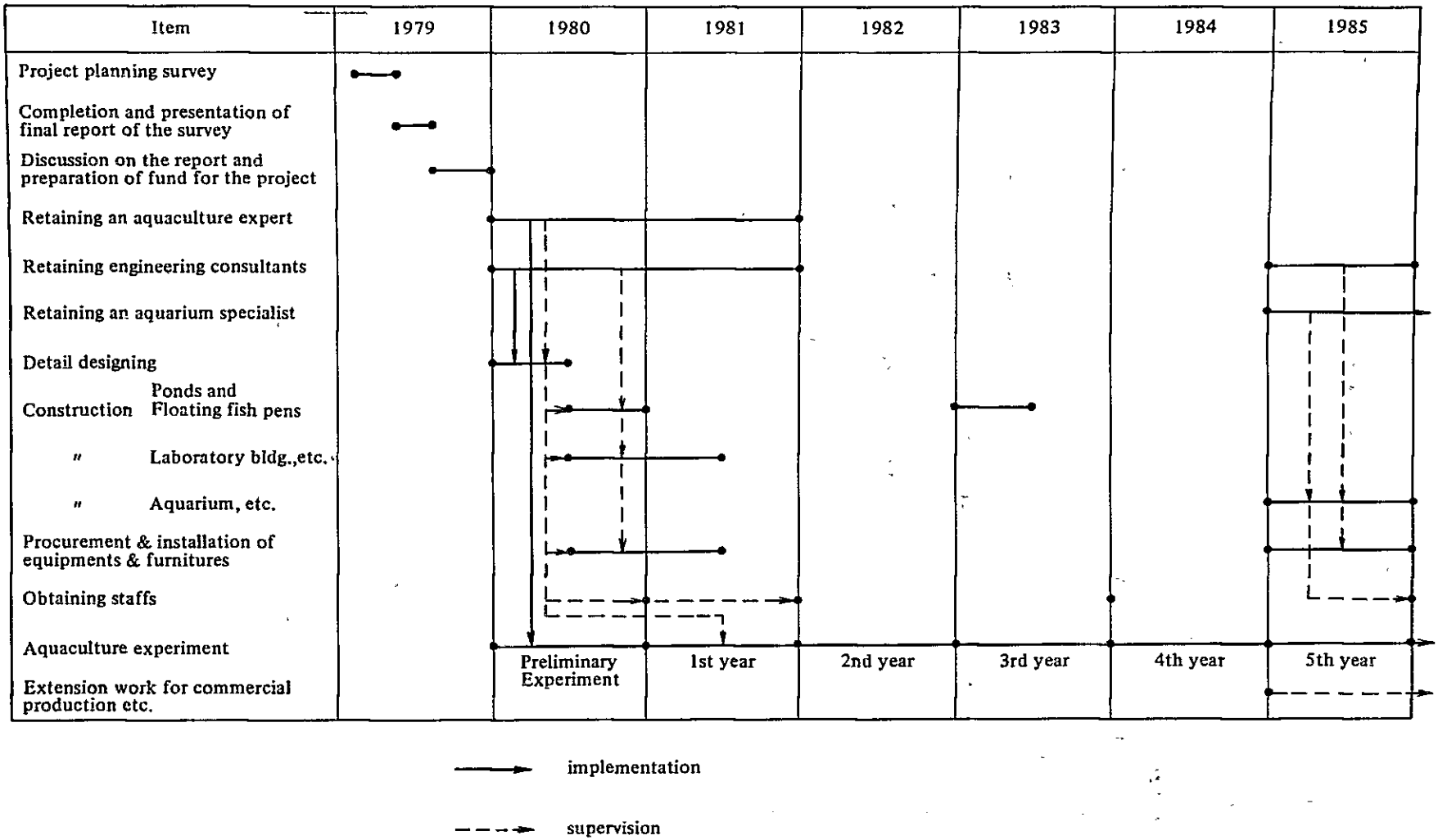
To construct and to manage the Center, the following budget will be neccessary. Consultant fee is estimated as 10% of the cost for construction, equipments and furnitures. Concerning to the Preliminary Experiment, explanation will be given later.

Item	1980	1981	1982	1983	1984	1985
Consultant Fee (Survey, Detail Planning, Supervision)	314,500	314,500				
Construction	1,912,250	1,665,650		212,500		2,499,600
Equipments & Furnitures	450,000	450,000		54,000	54,000	100,000
Wages		353,200	685,000	685,000	707,400	707,400
Aquaculture Feed		36,000	36,000	36,000	18,000	18,000
Expendables (Chemicals, Office Supplies etc.)		36,000	36,000	36,000	54,000	54,000
Water, Fuel, Electricity		15,000	53,000	53,000	57,000	57,000
Contingency	*50,000	44,000	81,000	81,000	84,000	84,000
Total	2,726,750	2,914,350	891,000	1,157,500	974,400	3,520,000

* For preliminary experiment

7) Time schedule

Time schedule from the present survey to the proper operation of the Center is summarized as follows:



Explanations of the schedule

To start the actual works to establish UAE Mariculture Center, the following two conditions should be satisfied:

1) The construction site for the Center is aproved by Umm Al Quwain local authority.

2) The budget for the construction and management of the Center is secured.

A decision by UAE government to establish the Center will be the precondition to the above.

Once the decision by the government is made, one or two aquaculture specialists should be invited immediately. The specialists will start experiments on artificial production of aquaculture seed of shrimp and rabbitfish in small scale with tentative facilities. The experiment will require one year period to obtain enough informations for the future activities of the Center.

The site and the budget should be secured in this period and then construction consultants should be invited. The consultants will work out detail designing of the facilities taking the advices of the aquaculture specialists into consideration. The consultants will be in charge of supervision of construction work, procurement and installation of equipments and furnitures and test run of facilities.

To reduce the experimental period, ponds, floating fish pens and wharf which are indispensable for the aquaculture experiments should be completed at first. The first year experiment will be started as soon as these facilities are completed. The aquaculture specialists will supervise the recruitment of presonnels and assist the first year experiment.

The budget needed to invite the aquaculture specialists or aquarium specialists is included in the consultant fee in the budget plan.

2. PLAN OF AQUACULTURE EXPERIMENTS FOR UAE MARICULTURE CENTER

1) Preliminary experiment

Since artificial seed production is essencial for the aquaculture development in UAE, preliminary experiments should start immediately without waiting the completion of the facilities to find the most suitable techniques to rear seeds specially of shrimp and rabbitfish. The experiment will be conducted using small scale, tentative equipments such as 0.5 ton and 1 ton plastic tanks and 10 ton canvas tanks during the period of one

year.

During this period, the route to obtain matured and healthy shrimp spawners from local shrimp fisheries in Abu Dhabi should be set up. In case spawners will not be obtainable from Abu Dhabi, methods to import spawners from Kuwait, Bahrain or Qatar should be studied

Spawners will be placed in 0.5 ton plastic tanks for spawning. Spawned eggs will be reared to juvenile stage in plastic and canvas tanks.

Males and females of rabbitfish with well developed gonads will be collected at the end of March and cultured in 1 ton plastic tanks as parent fish. Eggs of the fish will be obtained either by spontaneous spawning in the tank or artificial insemination. Obtained eggs will be reared in plastic and canvas tanks to juvenile stage.

The equipments and the materials required for the preliminary experiment period are as follows:

Item	Qtty.	Estimated Price in UAE
0.5 ton plastic tank	5 pcs.	Dh. 7,200
1 ton plastic tank	5 pcs.	9,000
10 ton canvas tank	2 pcs.	11,000
Small compressor	2 units	3,600
Small submersible pump	3 units	3,600
Materials for aeration		3,600
Brine shrimp egg	2 kg	1,800
Shrimp feed	10 kg	500
Total		40,300

2) First year experiment

In the first year, sand ponds and floating fish pens should be ready for use.

Shrimp. Juvenile shrimps which appear in Halodule areas of the lagoon in March and April or artificial seeds produced in the preliminary experiment will be cultured in 2,500 m^2 sand pond. They will grow up to 40 g in average body weight by November or December. Survival rate of 50% and production of 100 kg is intended for this year.

Formulated shrimp feed imported from Japan and trash fish will be fed to the shrimps. Fertilization of the culturing pond by organic fertilizers such as poultry wastes will be studied.

Rabbitfish. Juvenile rabbitfish of 1-4 cm in size which appears in Halodule areas of the lagoon in May and June or artificial seeds produced in the preliminary experiment will be grown in a pond and in floating fish pens. Four thousand seeds will be placed in 2,500 m^2 pond together with mullets and 500 seeds each in two 3 m x 3 m x 2 m floating fish pens. The fish will grow up to 150 g in 10 months. Survival rate of 40% and production of 300 kg are aimed at in the year. Entermorpha abundantly growing in the lagoon can be used as feed for the fish as well as formulated fish feed from Japan and trash fish.

Mullet. Juvenile mullets of 2-3 cm size which appear in shallow sandy areas of the lagoon will be collected as seeds for culture. Four thousand of the seeds will be grown in 2,500 m^2 pond together with rabbitfish and 1,000 will be grown in two 3 m x 3 m x 2 m floating fish pens. They will grow up to 200 g within a year. Survival rate of 40% and 400 kg production is aimed at in the year. Formulated feed imported from Japan and trash fish will be used as feed for the fish.

3) Second year experiment

Laboratory, feed production building, concrete tanks etc. can be used from this year.

Shrimp Two hundred and fifty thousand of artificial seeds and 200 kg of commercial size shrimp will be produced in a 200 ton tank and in a 2,500 m^2 pond, respectively.

Rabbitfish Fifty thousand of artificial seeds and 600 kg of commercial size fish will be produced in 50 tons tank, a 2,500 m^2 pond and floating fish pens.

Mullet Eggs will be collected artificially from the fish being cultured from the previous year. Fifty thousand seeds and 800 kg of commercial size fish will be produced in tanks, a pond and floating fish pens.

4) Third year experiment

In this year production of both artificial seeds and commercial size fish or shrimp will be doubled to the previous year and thus the fundamental techniques for commercial mariculture will be established. Two sand ponds and five floating fish pens will be constructed in this year for experiments in the following years.

5) Fourth and fifth years plan

Experiments will be made to reduce the produciton costs of artifical seeds and commercial size fish and shrimp in these two years. Production of formulated feed made of local materials such as sun dried fish and alfalfa will be studied.

The economically justified techniques for commercial mariculture of shrimp, rabbitfish and mullet will be established in this period. Also extension workers to help commercial fish farmers will be trained.

3. PLANING OF FACILITY

(1) Selection of construction site

In considering various factors such as oceanographic and biological conditions, construction condition, public land availability, transportation, water and electric power supply etc. the reclaimed area located west-coast in the lagoon of Umm Al Quwain with an area of 2 square kilo-metre will be the most suitable site for establishment of the mariculture center. (Fig. 14)

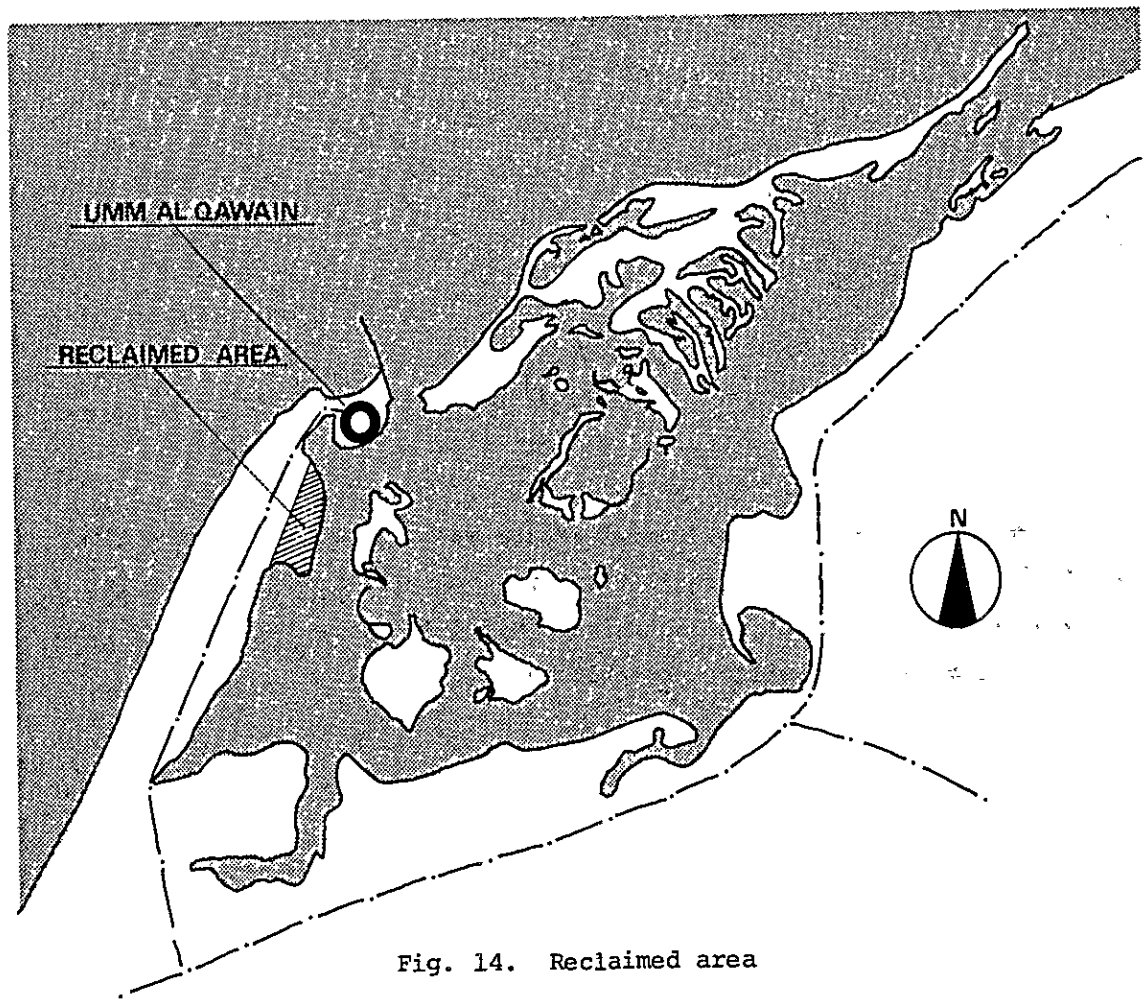


Fig. 14. Reclaimed area

The reclaimed area has the width of about 2 kilometre from north to south and 1 kilometre from east to west and is generally flat. The surface soil is sandy and ground level is 1.23 M above H.W.L. and the surface condition is almost flat. As the first recommended site for the mariculture center, the southeastern part on the reclaimed area was selected. (Fig. 15) Where some suitable tidal land for constructing sand pond are available.

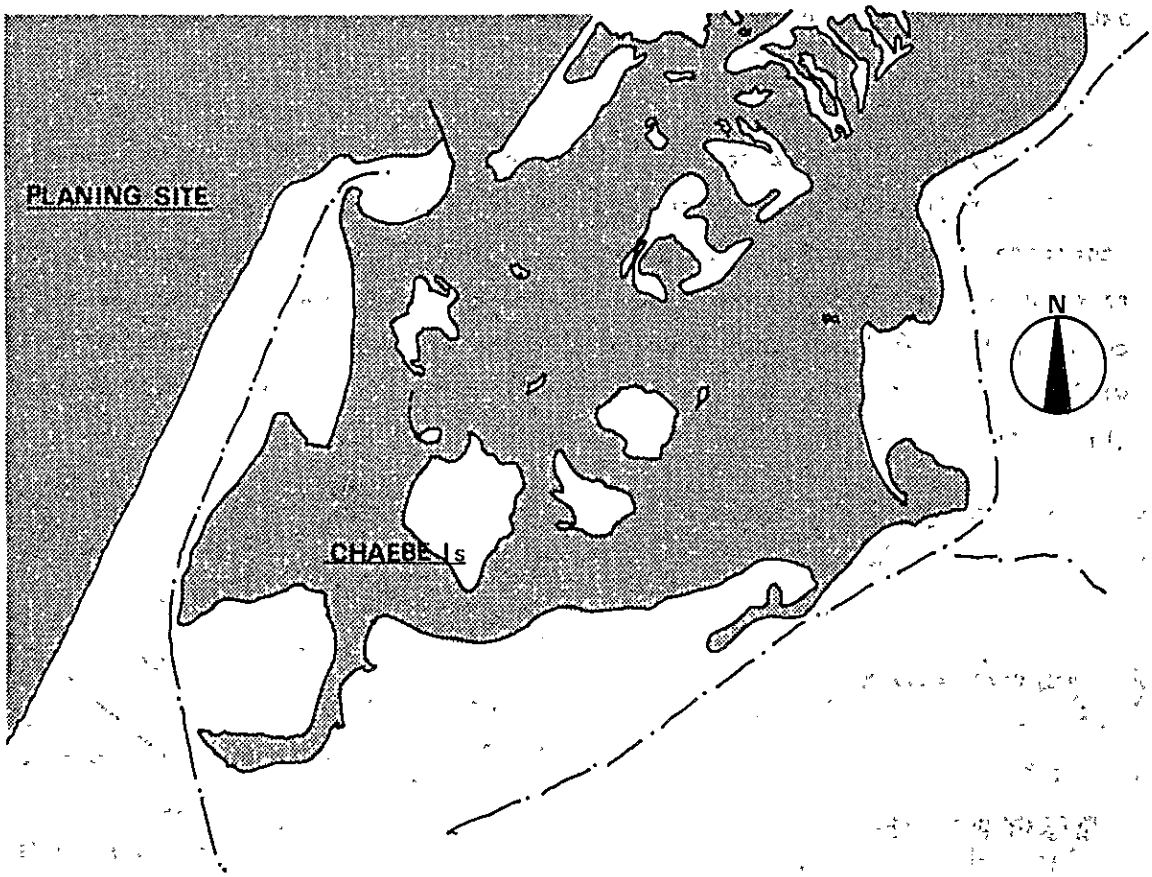


Fig. 15. First site

The northeastern part of the reclaimed are was also studied as the alternative site where the land facilities will be built and the Chaebe Is, located in the opposite side where such tidal facilities as culture pond and floating fish pen will be established. (Fig. 16)

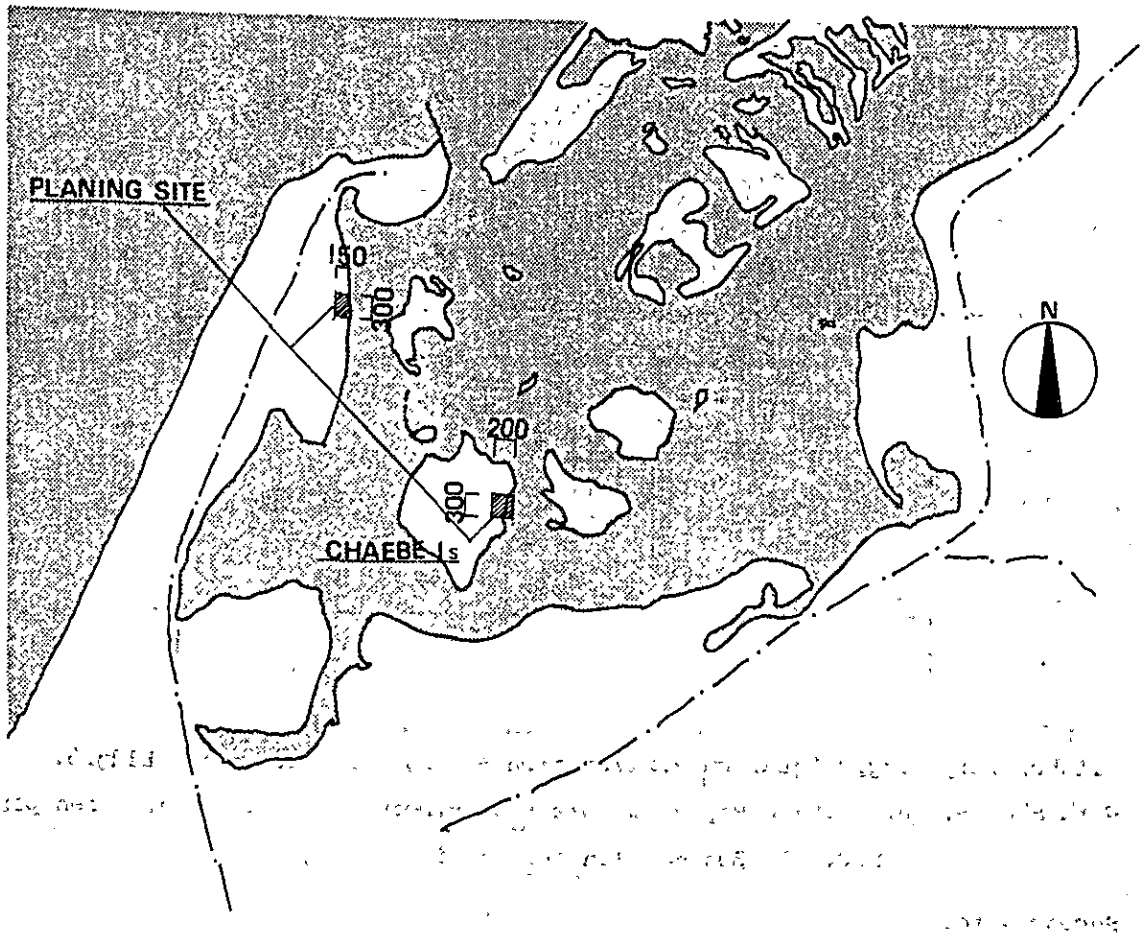


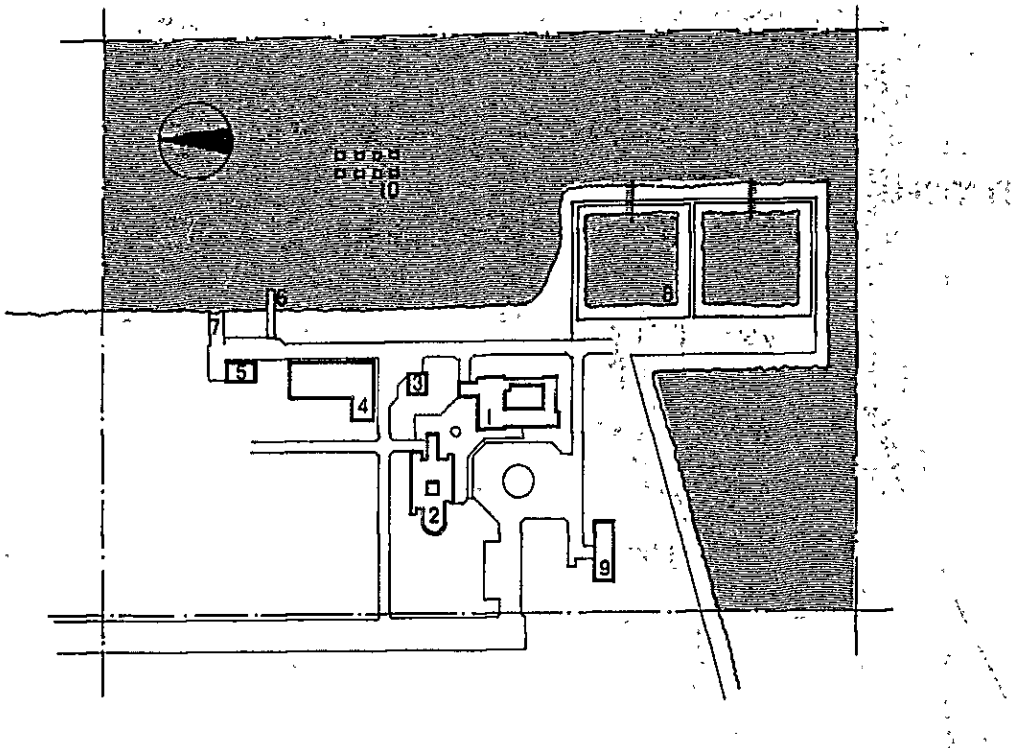
Fig. 16. Second site

The total area for the Center at the first site will be about 120,000 squar metre including both land and tidal area and for the second site 45,000 square metre for land facilities and 60,000 square metre for tidal facilities totaling 105,000 square metre will be required.

(2) Zoning plan

First site: (Fig. 17)

The laboratory building and aquarium will be located at the center of the site and the sand pond will be arranged in the south side of the buildings. The workshop, feed production building, concrete tanks and filtration building are gatherd in the north portion of the site.



1.Laboratory Bldg. 2.Aquarium 3.Filtration Bldg. 4.Feed Production Bldg. 5. Work Shop 6.Wharf 7.Slip Way 8.Culture Pond 9.Dormitory 10.Floating fish pen

Fig. 17 Zoning plan for the first site

Second site:

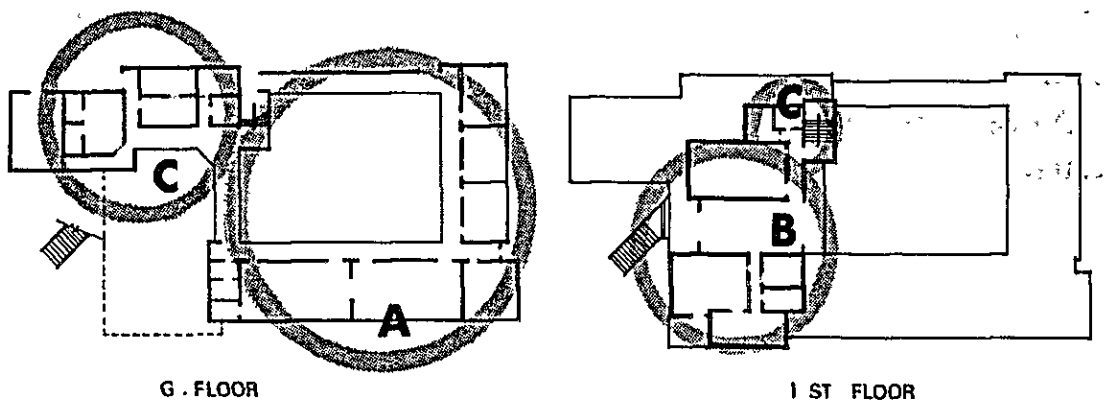
The land facilities will be arranged in the same manner as in the first site. The floating net pen and sand pond will be established on the tidal area of about 300 m x 200 m.

3) Outline of Buildings

(1) Laboratory Bldg.

1. Facility outline

The functional space can be classified as shown below.



A: Research space

This space will be for basic research on production of seed and technical development of aquaculture. This space includes two laboratories, one dark room, one meeting room, one library, one sample room and two store rooms.

Piping systems for sea water, fresh water and compressed air are provided to two laboratories.

B: Administration space

One entry hall, two office rooms, one service room, one store room and one audio-visual room for 30 audiences are included.

This space will control and support all activities in this center.

C: Service space

This space is used for machine room, toilet, corridor, locker room watch man room and staircase.

The machine room houses fresh water pump and emergency back-up diesel generator.

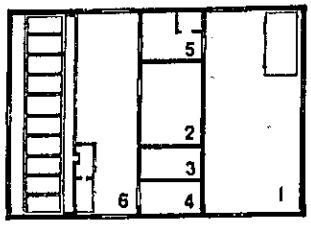
2. Building Outline

° Floor space	910 m^2
° Structure	Reinforced concrete structure with two stories.
° Finish ◦Roof	Asphalt-waterproof after light weight concrete pavement.
◦Outer wall	Tile and mortar with spray coating of colored cement finish.

3. Building Equipment

◦Water supply	Fresh water to toilet, dark room, service room and machine room.
	Pipe systems for fresh water, sea water and compressed air for laboratory.
	Hot water to shower room.
◦Electrical equipment	Each room will have necessary light, outlets and switches.
	Emergency back-up diesel generator to machine room.

◦Air conditioning	Window-type air conditioners for each room, except corridor, toilet, store room, locker room, stairecase and machine room.



1. Fish food preparation room
2. Laboratory
3. Cultivation room
4. Machine room
5. Toilet
6. Larval food cultivation room

(2) Feed Production Bldg.

1. Facility outline

This facility is for the culturing of zoo-and phytoplankton as larval feed and for preparation of feed for the cultured fish. There will be one larval feed cultivation room, one laboratory, one phytoplankton cultivation room, one machine room, one toilet and fish food preparation room. Compressed air system for aeration, air conditioner for keeping the room temperature constant and the light bank will be installed in the phytoplankton cultivation room. One refrigerator (-5°C, 15 m^3 capacity) and one freezer (-25°C, 15 m^3 capacity) are installed in the fish feed preparation room.

The machine room houses air blower.

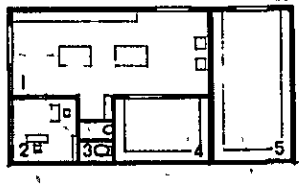
2. Building outline

◦ Floor space		216 m^2
◦ Structure		Reinforced concrete structure with one story.
◦ Finish	◦ Roof	Asphalt-waterproof after light weight concrete pavement.
	◦ Outer wall	Mortar with spray coating of colored cement finish.

3. Building equipment

◦ Water supply	Fresh water to toilet, and fish food preparation room. Pipe systems for fresh water, sea water and compressed air for larval feed cultivation room.
◦ Electrical equipment	Each room will have necessary light, outlets and switches.
◦ Air conditioning	Window type air conditioners for each room, except toilet and machine room.

(3) Workshop



1. Work shop
2. Office
3. Toilet
4. Store room
5. Fishing gear store room

1. Facility outline

This facility is designed for maintaining and repairing outboard engine, waterpump fishing gears, small fishing boats and associated gears and consists of work shop, office, toilet, store room and fishing gear store room.

2. Building outline

∘ Floor space		153 m^2
∘ Structure		Reinfored concrete structure with one story.
∘ Finish	∘ Roof	Asphalt-waterproof after light weight concrete pavement.
	∘ Outer wall	Mortar with spray coating of colored cement finish.

3. Building equipment

∘ Water supply	Fresh water to work shop and toilet.
∘ Electrical equipment	Each room will have necessary lights, outlets and switches.
∘ Other equipment	One 0.5 ton hoist crane.

(4) Filtration bldg.

1. Facility outline

Sea water intake, pumping and filtration system with 2,000 ton/day capacity.

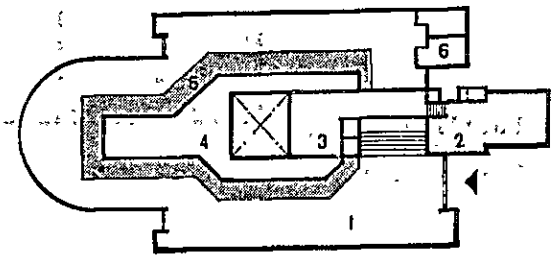
2. Building outline

∘ Floor space		175 m^2
∘ Structure		Reintorced concrete structure with two stories.
∘ Finish	∘ Roof	Asphalt-waterproof after light weight concrete pavement.
	∘ Outer wall	Motar with spray coating of colored cement finish.

3. Building equipment

∘ Water supply	Fresh water to machine room.
∘ Electrical equipment	Each room will have necessary lights, outlets and switches.

(5) Aquarium



1. Visiter hall
2. Office
3. Staff Room
4. Maintenance area
5. Aquarium
6. Toilet

1. Facility outline

This facility will be constructed to explain the concept of aquaculture to the people and to arouse their interest in the marine life. The fish of Arabian Gulf and each life stage of aquacultured animals will be exhibited in the aquarium. There will be office, visiter hall, staff room, maintenance area, toilet and machine room. The machine room houses air blower for aeration of aquarium tanks.

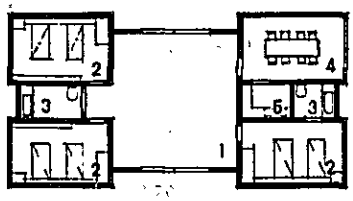
2. Building outline

∘ Floor space		846 m^2
∘ Structure		Reinforce concrete structure with two stories.
∘ Finish	∘ Roof	Asphalt-waterproof after light weight concrete pavement.
	∘ Outer wall	Tile and mortar with spray coating of colored cement finish.

3. Building equipment

∘ Water supply	Fresh water to toilet, staff room and machine room. Pipe system for fresh water, sea water and compressed air for each aquarium tank and remedial tank.
∘ Electrical equipment	Each room will have necessary lights, outlets and switches.
∘ Air conditioning	Air conditioner for each room except toilet and machine room
∘ Other equipment	One lift for carrying fish food to 1 st floor. One freezer for storing fish food.

(6) Dormitory



1. Living room
2. Bed room
3. Bath room
4. Dining room
5. Kitchen

1. Facility outline

This facility is designed to accomodate researchers and trainees for a certain period of time. There will be one living room, one dining room, one kitchen, two bath-rooms, and three bed rooms.

2. Building outline

∘ Floor space		176 m^2
∘ Structure		Reinforce concrete structure with one story
∘ Finish	∘Roof	Asphalt-waterproof after light weight concrete pavement
	∘Outer wall	Tile finish

3. Building equipment

∘ Water supply	Fresh water and hot water to bathrooms and kitchen.
∘ Electrial equipment	Each room will have necessary lights, outlets and switches.
∘ Air condition-ing	Window-type air conditioner for each room except bathrooms and kitchen.

(7) Other facilities

∘ Culture tank	8 ton (2m x 4m x 1m)	10 tanks
	50 ton (5m x 5m x 2m)	5 tanks
	200 ton (10m x 10m x 2m)	3 tanks
	(pipe systems for fresh water, sea water and compressed air for each tank)	
∘ Culture pond	50m X 50m	4 ponds
	(With sea water supply pump and aeration fan)	
∘ Floating fish pen	3m x 3m x 2m	10 pcs.
∘ Slip way	5m x 20m	
∘ Wharf	3m x 20m	
∘ Sea water intake	Two 150mm dia. PVC pipe lines of 50m long will be extended to the sea	

bottom of 4 metre deep in front of the Center.

- Other facilities
  - Road — 12,000 m^2 in total area of pavement for the access road and inside road.
  - Gate — 2 places
  - Fence — Height; 180cm, Length; 450m

4. COST ESTIMATION FOR UAE MARICULTURE CENTER PROJECT

1). Construction cost

(Dh.)

Facility	Cost estimation
Laboratory bldg.	910m^2 x 1,300Dh. x 1.3*1 = 1;537,900
Feed production bldg.	216m^2 x 1,000Dh. x 1.3*1 = 280,800
Cold storage	15m^3 x 2 units 73,000
Filtration bldg.	175m^2 x 2,000Dh. x 1.3*1 = 445,000
Workshop	153m^2 x 1,000Dh. x 1.3*1 = 198,900
Tank	200ton(3), 50ton(5),8ton(10) 254,200
Pond	2,500m^2 (4) 340,000
Floating fish pen	3m x 3m x 2m (10) 85,000
Wharf and slip way	34,100
Road *2	12,000m^2 x 40Dh. = 480,000
Fence *2	450m x 70Dh. = 31,500
Gate *2	= 15,000
Lights draining ditch*2	= 15,000
Aguarium	846m^2 x 2,000Dh. x 1.3*1 = 2,199,600
Dormitory	176m^2 x 1,300Dh. x 1.3*1 = 300,000
Total	6,290,000

Note: *1; 30% of inflation allowance is considered for building construction.

*2; Basing on Japanese standard.

2). Wages

(Dh.)

1. Director (more than 15 years experience, married)

Basic salary	6,000 x 12	= 72,000
Housing allowance	72,000 x 0.6	= 43,200
Living expense allowance	72,000 x 0.2	= 14,400
Transportation allowance	300 x 12	= 3,600
	Total	133,200 /year

2. Researcher (more than 5 year experience, married)

Basic salary	4,000 x 12	= 48,000
Housing allowance	48,000 x 0.6	= 28,800
Living expense allowance	48,000 x 0.2	= 9,600
Transportation allowance	300 x 12	= 3,600
	Total	90,000 /year

3. Researcher (Married)

Basic salary	2,500 x 12	= 30,000
Housing allowance	30,000 x 0.6	= 18,000
Living expense allowance	30,000 x 0.2	= 6,000
Transportation allowance	300 x 12	= 3,600
	Total	57,600 /year

4. Assistant, Mechanic, Electrician, Clerk, Typist (Single)

Basic salary	1,200 x 12	= 14,400
Housing allowance	14,400 x 0.45	≒ 6,500
Living expense allowance	14,400 x 0.2	≒ 2,900
Transportation allowance	300 x 12	= 3,600
	Total	27,400 /year

5. Driver (Married)

Basic salary	1,000 x 12	= 12,000
Housing allowance	12,000 x 0.6	= 7,200
Living expense allowance	12,000 x 0.2	= 2,400
Transportation allowance	300 x 12	= 3,600
	Total	25,200 /year

6. Office boy, Watchman (Married)

Basic salary	750 x 12	= 9,000
Housing allowance	9,000 x 0.6	= 5,400
Living expense allowance	9,000 x 0.2	= 1,800
Transportation allowance	300 x 12	= 3,600
	Total	19,800 /year

3). Water, Electricity and Fuel

Year	Water	Electricity	Fuel	Total
1981	1(ton)x300(day) x 33 (Dh.) ≒ 1,000(Dh.)	For ponds 25 (kw) x 12(hr.) x 200(day) x 0.075(Dh.) ≒.4,500(Dh.)	15(gallon)x 200(days) x 2.85(Dh.) ≒.8,600(Dh.)	≒.15,000
1982, 1983	3(ton)x300(day) x 3.3 (Dh.) ≒.3,000(Dh.)	For ponds 25(kw) x 12(hr.) x 200(day) x 0.075(Dh.) ≒.4,500(Dh.) For Laboratory etc. 227(kw) x 7(hr.) x 300(day) x 0.075(Dh.) ≒ 36,000(Dh.)	15(gallon)x 200(days) x 2.85(Dh.) ≒.8,600(Dh.)	≒ 53,000
1984, 1985	3(ton)x300(day) x 3.3(Dh.) ≒ 3,000(Dh.)	For ponds 50(kw) x 12(hr.) x 200(day) x 0.075(Dh.) ≒ 9,000(Dh.) For Laboratory etc. 227(kw) x 7(hr.) x 300(day) x 0.075(Dh.) ≒ 36,000(Dh.)	15(gallon)x 200(days) x 2.85(Dh.) ≒ 8,600(Dh.)	≒ 57,000

4). Laboratory Equipments, Furnitures and Supplies.

(Price F.O.B. price in Japan converted to Dh. by the rate of 1Dh.=56 J.yen)

No.	Item	Model/Manufacturer	Qtty	Price(Dh)
1	Bottom sampler	Ekman-Berge type, Rigosha 2007	1 pc.	2,100
2	D.O. meter	Kyusui IP-2TN	1 pc.	5,900
3	Water sampler	Kitahara type, Rigosha 2030-B	1 pc.	1,300
4	Current meter	Toho CM-2	1 unit	11,800
5	Water quality analyzer	Horiba U-7	2 unit	11,800
6	pH meter	Horiba H-7HP	1 unit	1,200
7	Secchi disc	Rigosha 2500-B	2 pcs.	500
8	Binocular	Nikon 'TROPICAL' IF	1 pc.	500
9	Standard Sea Water	Certified by I.A.P.S.O.	30 pcs.	1,800
10	Thermometer with Metal Jacket	Yoshino	10 pcs.	700
11	Stereo microscope	Olympus SZ-Tr	1 unit	4,600
12	Underwater camera	Nikon NIKONOS-III	1 unit	2,700
13	Camera	Olympus OM-2	1 unit	2,300
14	Flat Scale 50 kg	Murayama B-50S	1 unit	2,800
15	Plankton net	Rigosha 2520	2 pcs.	1,200

16	Net cloths for above	Rigosha 2535(GG22, GG54, XX13; 20m each)	60 m	7,300
17	Aeration equipment	Rie-sea MD40, MD30	2 sets	2,400
18	Plastic tank	Earth EF-2000S (2ton)	10 pcs.	
		Shoyo STC M-1000(1ton)	10 pcs.	56,000
		Shoyo STC M-500 (500ℓ)	15 pcs.	
		Shoyo STC M-30 (30ℓ)	30 pcs.	
19	Aquarium materials	Tube, Valve, Connector, Airstone etc.	1 set	4,100
20	Projecting scope	Nikon	1 unit	35,000
21	Insulated plastic box	Risu R-80	10 pcs.	3,600
22	Aerator	Rei-sea AP-115RDC	2 pcs.	
		Goto MC-handy	10 pcs.	2,500
		Nissei NS-B2 105	8 pcs.	
23	Water distilling Apparatus	Ikemoto 5007		2,700
24	Centrifuge	Ikemoto 2252-B	1 unit	1,200
25	Analytical balance	Ikemoto 3106 LS-7	1 unit	5,600
26	Top pan balance	Alsep Top E-200	1 unit	1,000
27	Salinometer	Rigosha 2711	1 unit	17,900
28	Photoelectric colorimeter	Ikemoto 2532-0E5	1 unit	2,400
29	Voltage stabilizer	ASC-15	2 units	5,400
30	Microscope	Olympus CHA213	1 unit	3,600
31	Cabinet freezer	Sony EEH-182F	2 units	10,000
32	Refregerator	National NR-258AF	1 unit	1,700
33	Eyepiece micrometer	Ikemoto 2851	10 pcs.	500
34	Stage micrometer	Ikemoto 2852	5 pcs.	500
35	Vernier caliper	Yagami 1130-510, ST-150	3 pcs.	300
36	Sieve set	Ikemoto 4401	2 sets	1,000
37	Standard tool box	Iuchi E-0162	2 sets	600
38	Dissecting tool set	Rigosha 2555-B	3 sets	1,000
39	Haemocytometer	Ikemoto 2033	5 sets	1,100
40	Slide glass	Ikemoto 2855	200 pcs.	100
41	Cover glass	Ikemoto 2856	400 pcs.	100
42	Graduated cylinder	Ikemoto 3386	30 pcs.	2,300
43	Pipet	Ikemoto 3351	20 pcs.	200
44	Spoon set	Ikemoto 6298	3 sets	100
45	Tripod	Ikemoto 7052	10 pcs.	100
46	Test tube support	Ikemoto 7072 (A)-24	10 pcs.	200
47	Gass burner		10 pcs.	200
48	Pinch cocks	Ikemoto 7161	300 pcs.	300
49	Cork borer	Ikemoto 7261 (B)-12	3 sets	100
50	Brush (assorted)	Ikemoto 7292-7296	40 pcs.	100
51	Polyethylene bottle	Ikemoto 7403	150 pcs.	300
52	Polyethylene bottle aspirator	Ikemoto 7405	20 pcs.	1,000
53	Polyethylene washing bottle	Ikemoto 7408	40 pcs.	100
54	Polyethylene funnel	Ikemoto 7435	60 pcs.	100
55	Rubber bulb	Ikemoto 7526	100 pcs.	100
56	Rubber stopper	Ikemoto 7501	90 pcs.	100
57	Beaker	Ikemoto 8501	80 pcs.	700
58	Erlenmeyer flask	Ikemoto 8511	60 pcs.	700
59	Petri dish	Ikemoto 8551	20 pcs.	100
60	Watch glass	Ikemoto 8558	50 pcs.	100

61	Test tube	Ikemoto 8591	200 pcs.	300
62	Desicator	Ikemoto 8871	6 pcs.	1,000
63	Reagent bottle	Ikemoto 8801, 8806	70 pcs.	700
64	Museum jar	Ikemoto	10 pcs.	1,500
65	Plastic jar	Ikemoto	280 pcs.	1,800
66	Plastic tray		10 pcs.	200
67	Dissecting tray	Ikemoto	5 pcs.	200
68	Plastic storage bin		3 pcs.	1,200
69	Trolley	Ikemoto 7092	2 pcs.	1,200
70	Formalin		200 ℓ	700
71	Desicative		5 kg	100
72	Alcohol		50 ℓ	1,200
73	Central lab. table	Noys E-2	5 units	20,700
74	Stainless steel basin	Noys M-405	3 units	9,900
75	Stainless steel sink	Noys M-201	4 units	10,000
76	Reagent storage cabinet	Noys C-11	2 units	5,800
77	Drawing table & chair	Uchida 801-3002 S-2 LD-200 N-2	1 unit	3,400
78	Tracing table & chair	Uchida 803-0534 LD-200	1 unit	2,000
79	Laboratory stool	Okamura 2256AZ	10 pcs.	1,000
80	Storage cabinet	Okamura 3644AZ 4626AZ 4634AZ	3 units	4,600
81	Drawing device set	Uchida 850-1055,843-0101 817-0000,843-0201 843-1002,802-0840	2 sets	800
82	Rack for specimen jar	Okamura 6460 AM	4 sets	3,300
83	Aqua-lung equipment		1 set	4,000
84	Diving set		2 sets	700
85	Air compressor	Matsubara AVC-16A	1 unit	9,900
86	Projection screen	Elmo HS-4	1 unit	700
87	16mm movie projector	Elmo 16-CL	1 unit	4,100
88	35mm slide projector	Elmo AS-3000A	1 unit	2,300
89	Black board	Okamura 4391 ZZ	2 units	2,200
90	Full set of dark room equipments		1 set	1,800
91	Big mixer	Hanaki Seisakusho	2 unit	1,800
92	Mincing machine	Hanaki Seisakusho	2 unit	7,200
		Total		332,100

Above mentioned items are accommodated in laboratories, dark room and seed production building.

5) . Office Equipments & Furnitures

(FOB Japan)

No.	Item	Model/ Manufacturer	Qtty.	Price (Dh)
1	Steel rack	Okamura 6460 AM	20 units	16,500
2	Book shelf	Okamura 6816 AD	6 units	7,000
3	Magazine rack	Okamura 6801 ZZ	2 units	2,000
4	Folding Table	Okamura 8185 AZ	20 pcs.	8,400
5	Folding chair	Okamura 8153 BZ	44 pcs.	4,600
6	Cabinet (Glass door & steel door)	Okamura 4644 AZ 4624 AZ 4634 AZ	13 sets	19,800
7	File cabinet	Okamura 4273 ZB	4 pcs.	4,000
8	Big eeting table		1 pce.	7,000
9	Chair for meeting		10 pcs.	3,400
10	Plain cabinet		6 pcs.	4,800
11	Office desk & chair		5 sets	9,000
12	Office desk & chair for Director		1 set	3,000
13	Sofa set		1 set	4,300
14	Refregirator		1 unit	1,700
15	Lecture table & chair	Okamura 3121 ZE 2024 ZZ	1 set	900
16	Blackboard	Okamura 4391 ZZ	1 unit	1,100
17	Electric typewriter		2 units	14,000
18	Electronic calculator	Sharp EL-2110	2 units	500
19	Plain paper copying machine	Canon NP-50	1 unit	25,000
20	Work bench	Banzai T-1000	1 unit	1,900
	Total			138,900

Above mentioned items are accommodated in library, sample room, meeting room, store room, locker room, office room, director room, service room, store room for administration, lecture room, feed production building and work shop.

6). General Equipments

No.	Item	Model/ Manufacturer	Qtty.	Price(Dh)
1	Underwater pump	Tsurumi 4 cls	2 units	6,500
2	Portable generator	1.8 kW	2 units	3,400
3	Gasoline engine pump	150ℓ/min	2 unit	2,500
4	Car	Toyota Lard Cruiser (with A/C)	1 unit	33,200
5	Pick up car	Toyota Toyo-Ace	1 unit	28,000
6	FRP boat (5m) with 25HP out board engine	Yamaha, Asap	2 units	16,500
7	Radio transceiver	National RJ-56	1 set	1,500

8	Cage net for fish pen		20 pcs.	7,200
		Total		98,800

7). Fish and Shrimp Feeds (FOB Japan)

No.	Item	Model/ Manufacturer	Qtty.	Price
1	Brine shrimp egg	Tetra	20 kg	10,800
2	Shrimp feed	Nippai	750 kg	10,800
3	Fish feed	Nippai	750 kg	2,400
		Total		24,000

5. NEXT STEP TO BE TAKEN TO EASTABLISH UAE MARICULTURE CENTER

The next step of the present survey should be detail designing for the construction of the Center and preliminary experiment for seed production.

One or two aquaculture specialist will be required for the period of one year for the preliminary experiment. The aquaculture specialist will also act as coordinator to promote the process of the detail designing. He also should provide advises for detail designing from the user's side of the facilities.

Six month period will be required to complete datail design. One engineering company which is well experienced in the designing of aquaculture facilities should be in charge of it.

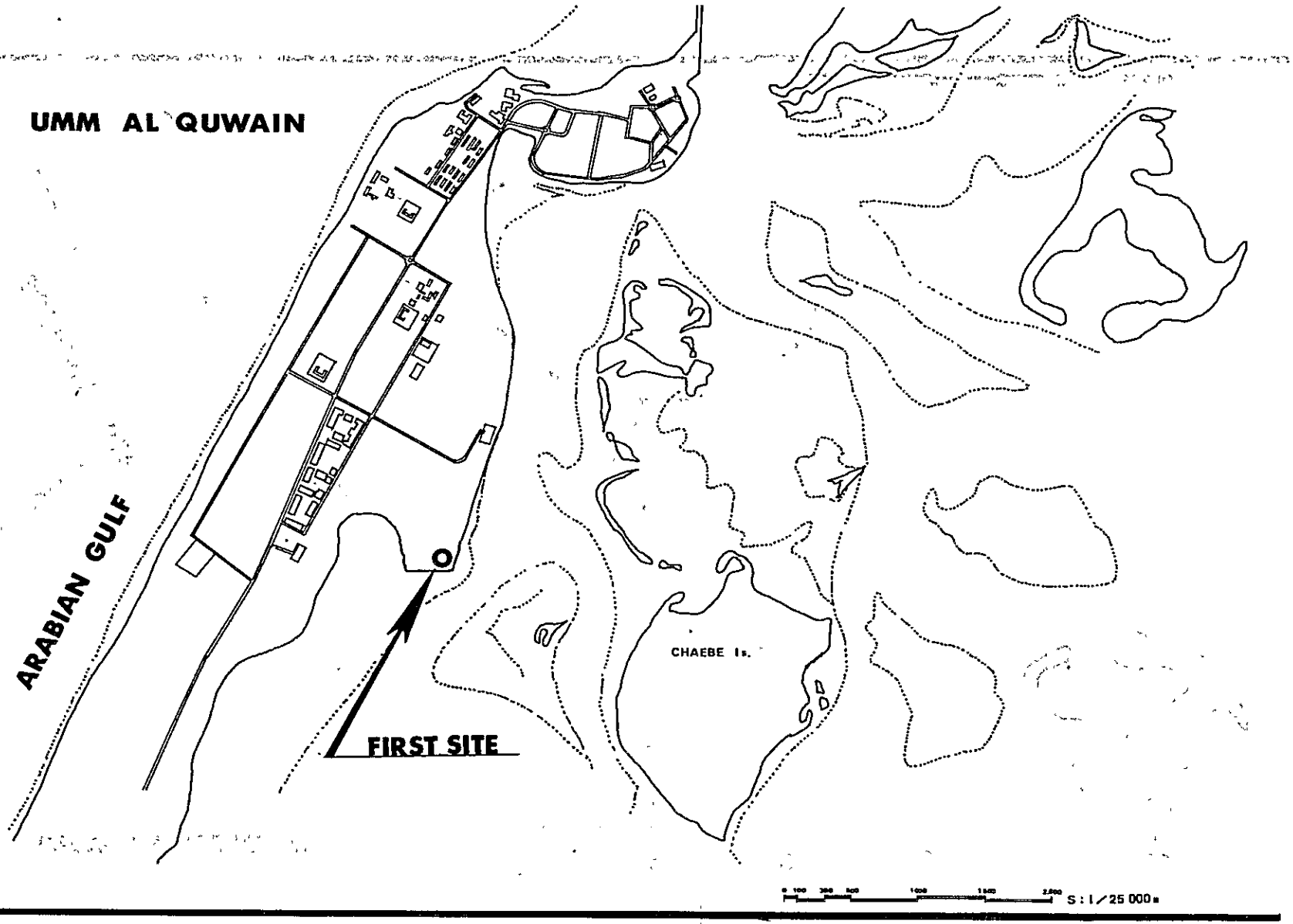
First one month of this period will be required for the survey at the construction site and for other miscellaneous surveys in UAE.

Detail design will be worked out in the next two months.

Then, the detail design will be brought to UAE, explained, checked and modified if required in one month period.

Final design and tender document will be completed in the next two months.

6. PLAN AND DRAWINGS OF BUILDINGS AND FACILITIES OF UAE MARICULTURE CENTER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ARABIAN GULF
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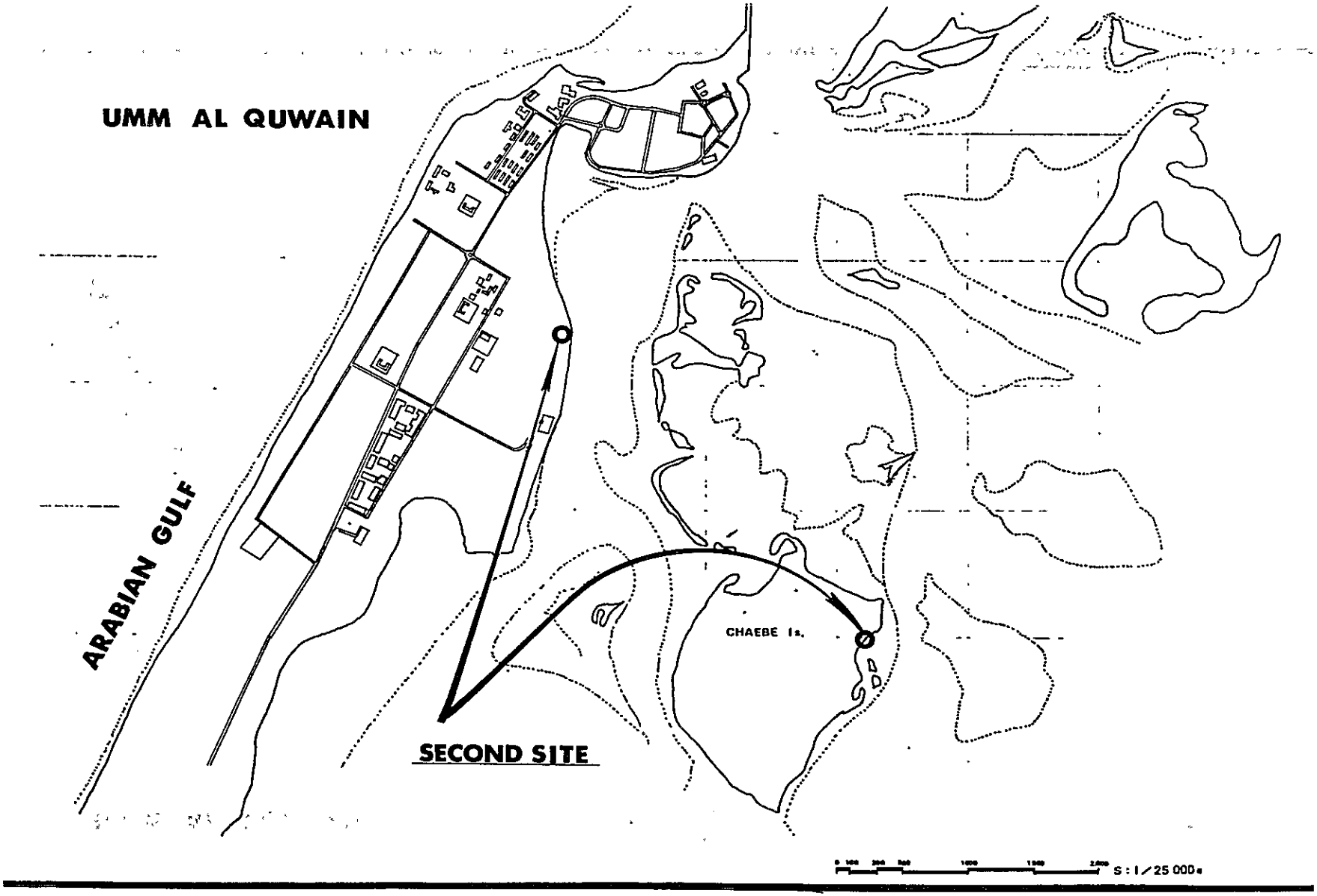
UMM AL QUWAIN
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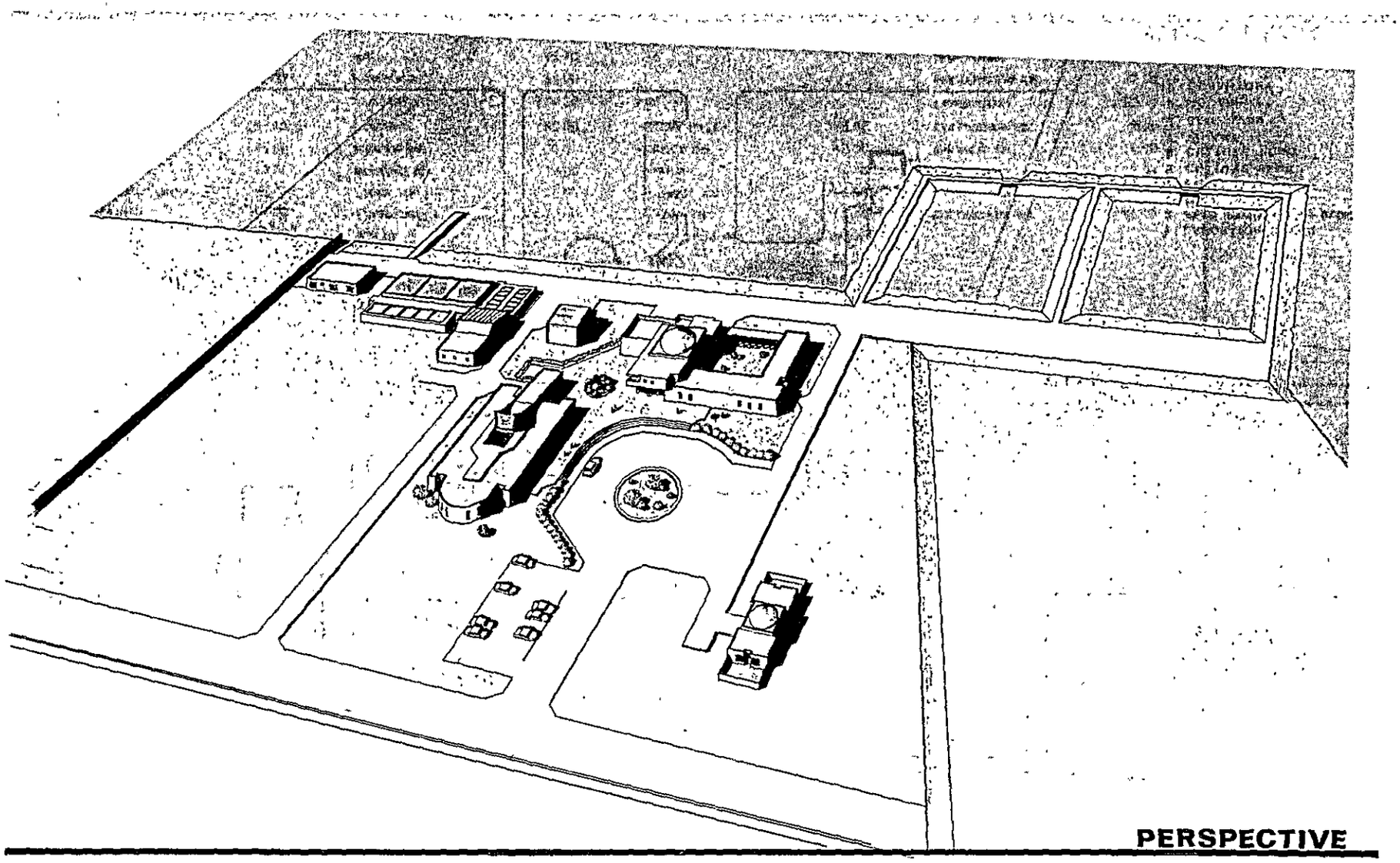
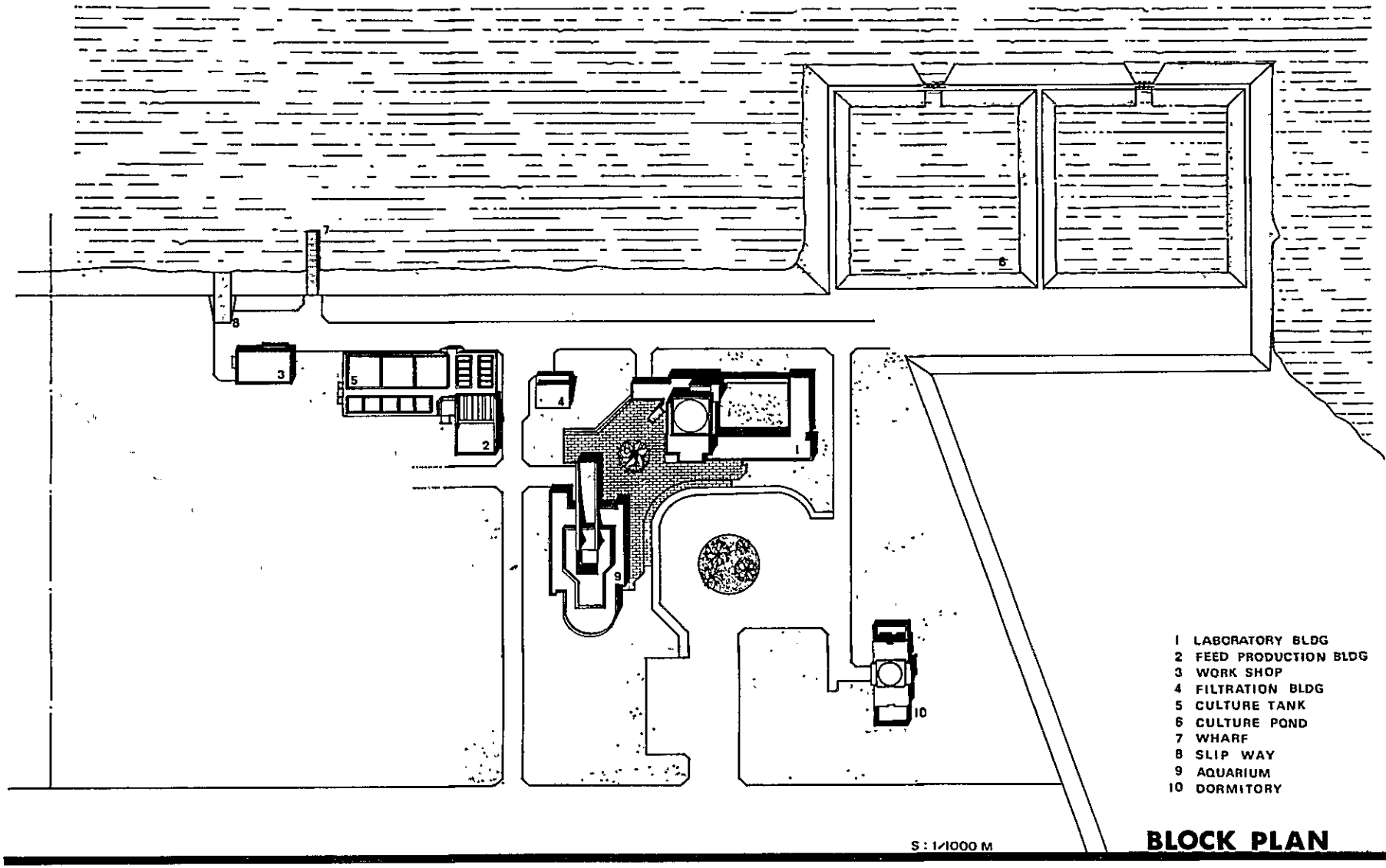


PERSPECTIVE

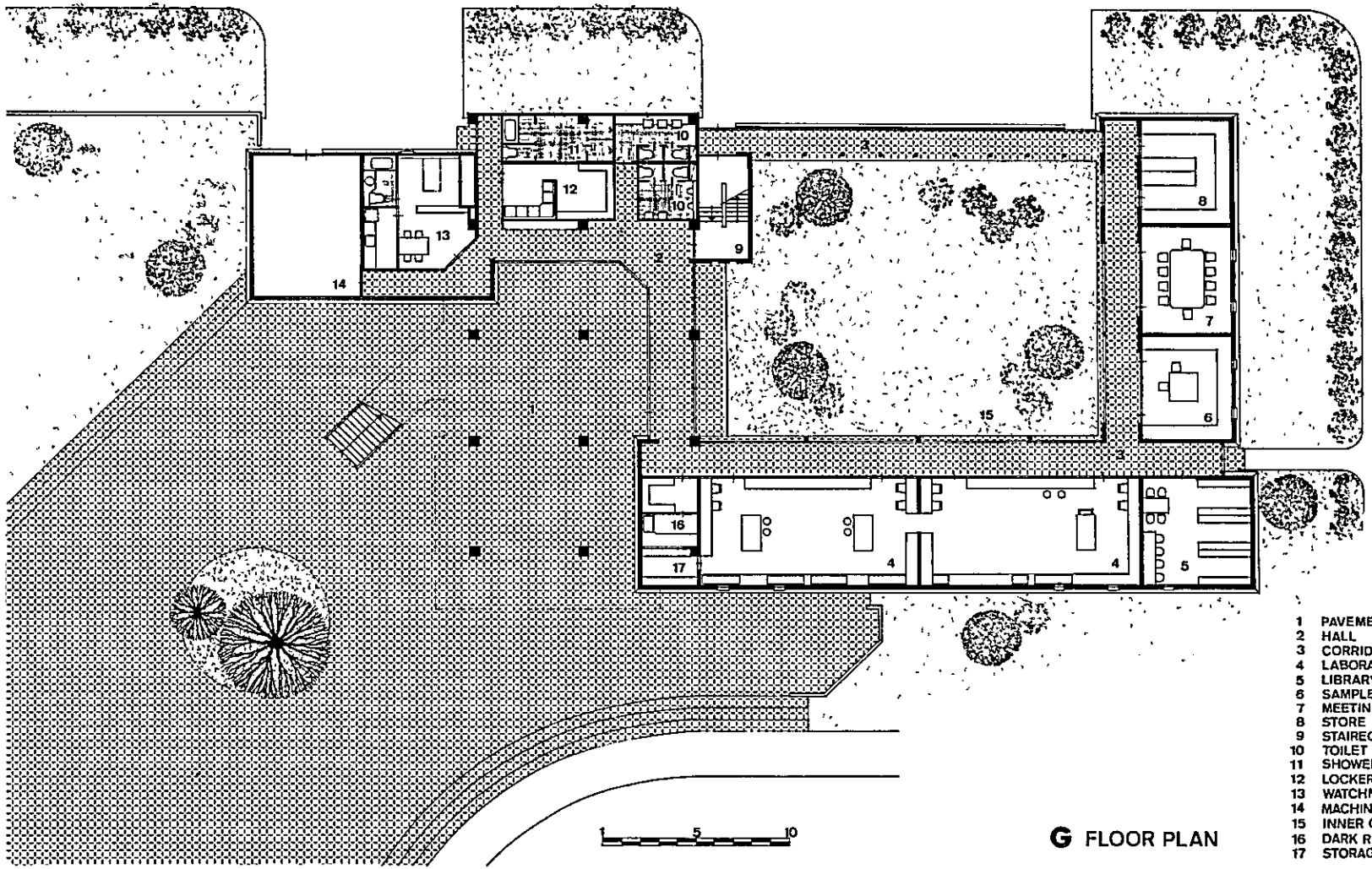

1 LABORATORY BLDG
2 FEED PRODUCTION BLDG
3 WORK SHOP
4 FILTRATION BLDG
5 CULTURE TANK
6 CULTURE POND
7 WHARF
8 SLIP WAY
9 AQUARIUM
10 DORMITORY
S : 1/1000 M

BLOCK PLAN

AQUARIUM		LABORATORY BLDG				SEED PRODUCTION BLDG		
B1FL		1FL		STORAGE	6 00	1FL		
VISITER HALL	52.00	HALL	75 70			FISH FOOD		
MACHINE RM	42 00	CORRIDOR	99 00			PREPARATION RM	72 00	
1FL		LABORATORY	144 00	2FL		LABORATORY	20 00	
VISITER HALL	352 00	LIBRARY	66 00	ENTRY HALL	88 80	CULTIVATION RM	8 00	
OFFICE	66 00	SAMPLE RM	30 00	OFFICE RM	48 00	MACHINE RM	8 00	
STAFF RM	42 00	MEETING RM	30 00	OFFICER	24 00	TOILET	12 00	
MAINTENANCE AREA	115 00	STORE RM	30 00	SERVICE RM	10 50	LARVAL FOOD		
AQUARIUM	128 00	STAIRECASE	18 00	STORE RM	14 70	CULTIVATION RM	96 00	
TOILET	30 00	TOILET	22 80	AUDI CLASS RM	60 00			
		SHOWER RM	15.00	TOILET	21 00			
OTHER	19 00	LOCKER RM	21 00	STAIRCASE	18 00			
		WATCHMAN RM	37 50					
		MACHINE RM	48 00					
		DARK RM	12 00					
TOTAL	846 00				910 00		216 00	

FILTRATION BLDG		WORK SHOP		DORMITORY			TOTAL	
1FL		1FL		1FL				
MACHINE RM	60 00	WORK SHOP	60 00	LIVING RM	64 00			
FILTERED SEA WATER		OFFICE	16 00	BED RM	72 00			
TANK	13 60	TOILET	8 00	DINING RM	24 00			
FILTER TANK	26 40	STORE RM	24 00	KITCHIN	8 30			
		FISHING GEAR	45 00	BATH RM	8 00			
2FL								
ELEVATED TANK	75 00							
TOTAL	175 00		153 00		176 00		2176 30	M²

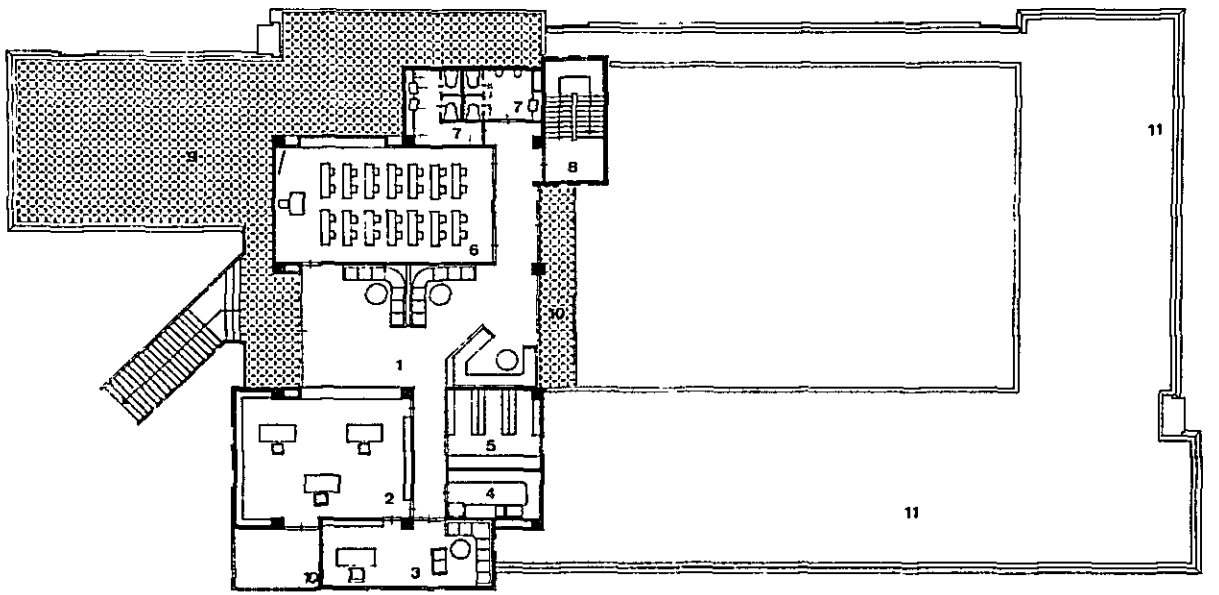
FLOOR AREA



1 PAVEMENT&PILOTIS
2 HALL
3 CORRIDOR
4 LABORATORY
5 LIBRARY
6 SAMPLE RM
7 MEETING RM
8 STORE RM
9 STAIRECASE
10 TOILET
11 SHOWER RM
12 LOCKER RM
13 WATCHMAN RM
14 MACHINE RM
15 INNER COURT
16 DARK RM
17 STORAGE

G FLOOR PLAN

LABORATORY BLDG

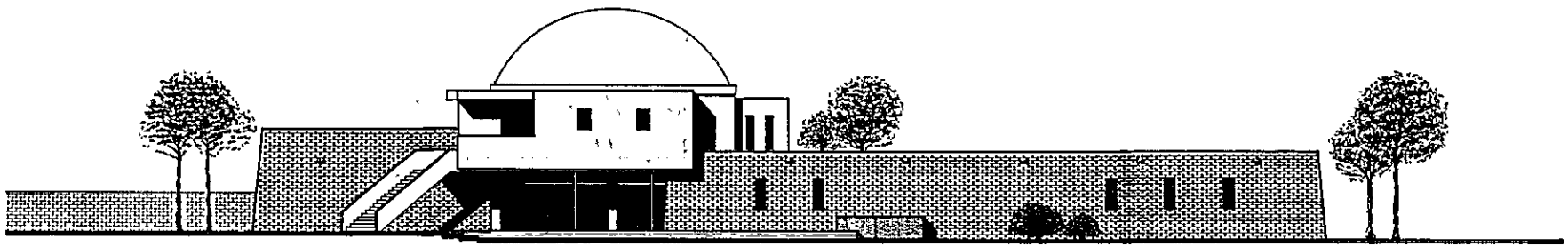


1 ENTRY HALL
2 OFFICE RM
3 OFFICER
4 SERVICE RM
5 STORE RM
6 AUDI CLASS RM
7 TOILET
8 STAIRCASE
9 ROOF DECK
10 BALCONY
11 FLAT ROOF

1 5 10

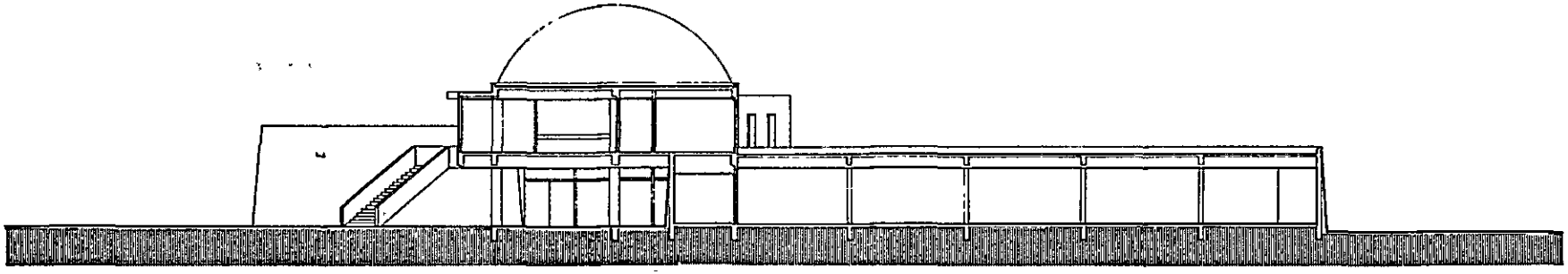
1ST FLOOR PLAN

LABORATORY BLDG



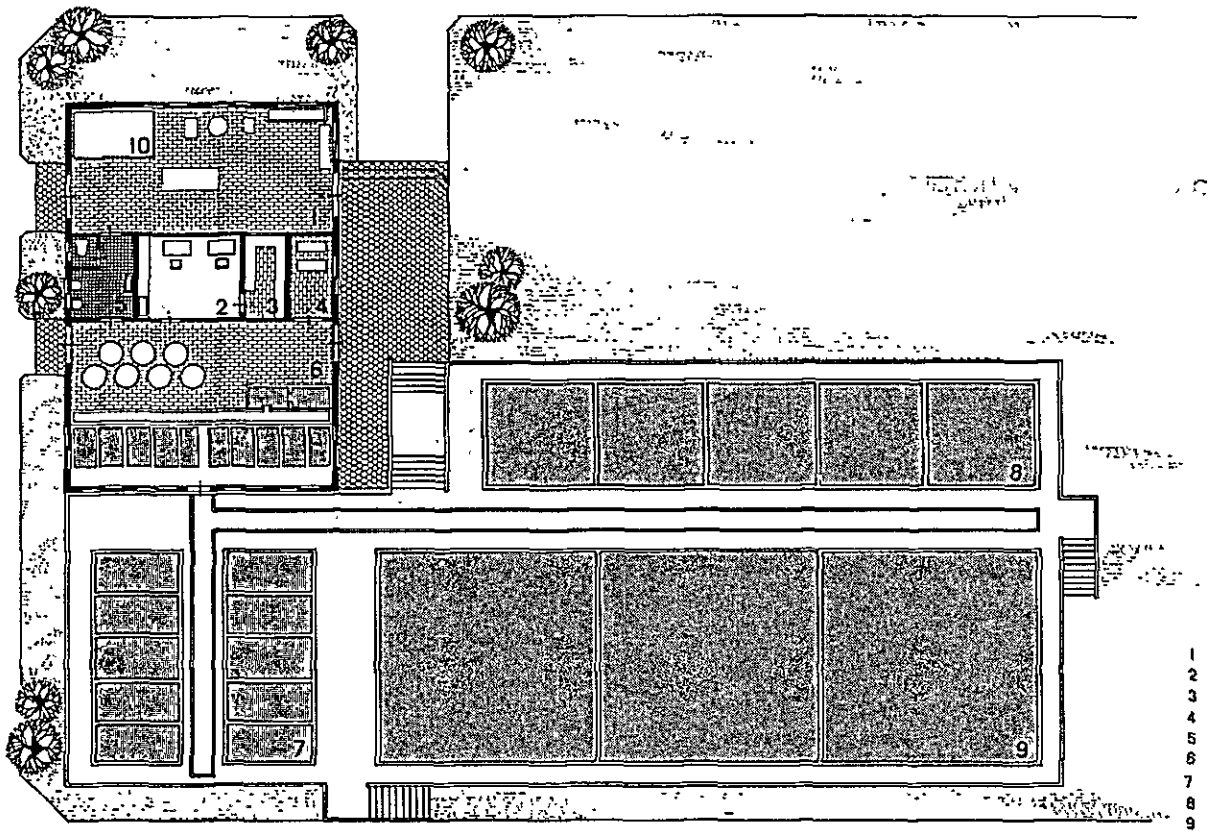
ELEVATION

LABORATORY BLDG



SECTION

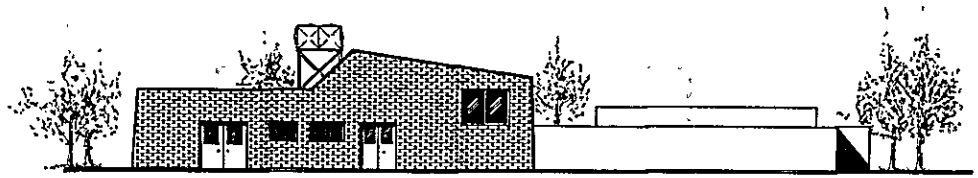
LABORATORY BLDG



FLOOR PLAN S 1/200M

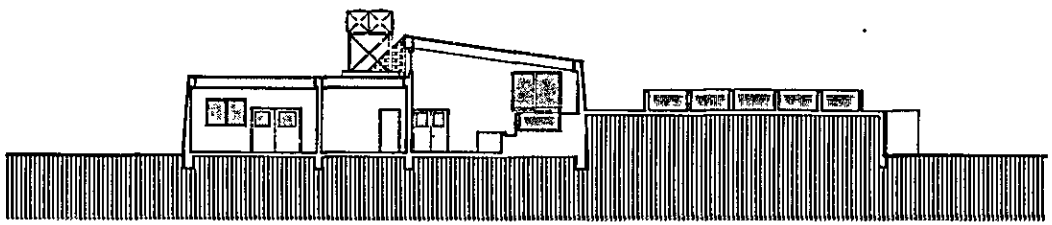
1 FISH FOOD PREPARATION RM
2 LABORATORY
3 CULTIVATION RM
4 MACHINE RM
5 TOILET
6 LARVAL FOOD CULTIVATION RM
7 8 TON TANK
8 50 TON TANK
9 100 TON TANK
10 FREEZER & REFRIGERATOR

FEED PRODUCTION BLDG



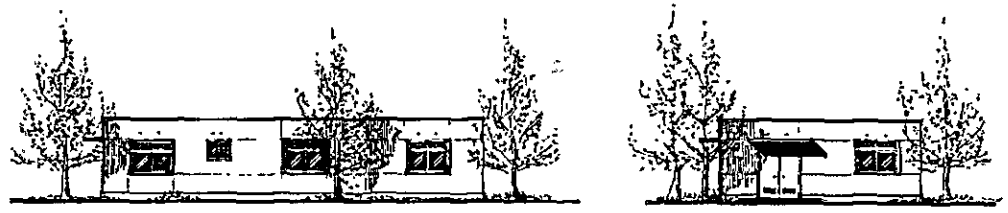
ELEVATION

ELEVATION

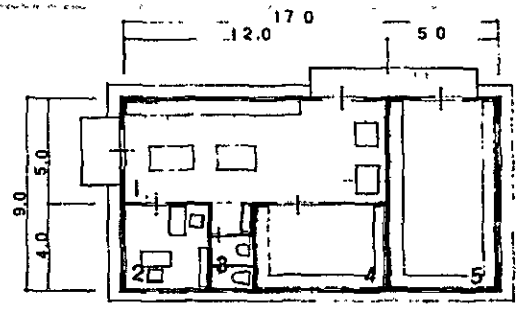


SECTION S 1/200

FEED PRODUCTION BLDG



ELEVATION S 1/200 M

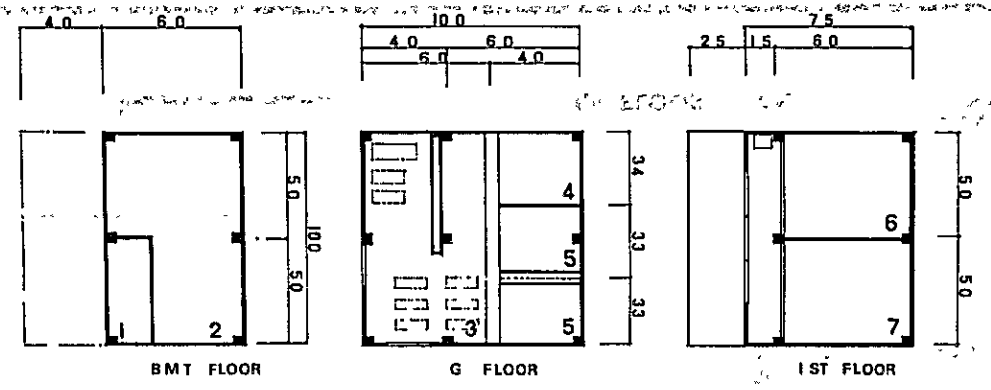


FLOOR PLAN S 1/200 M

WORK SHOP

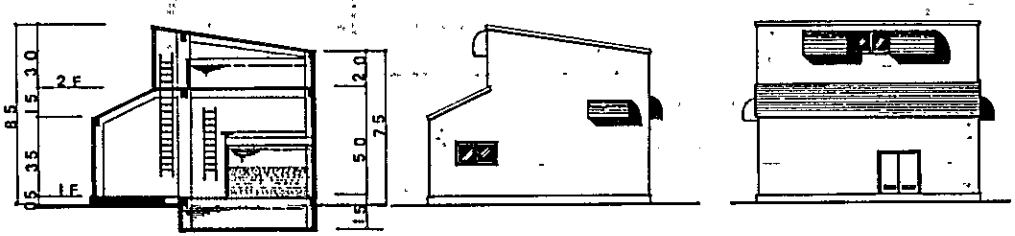
1 WORK SHOP
2 OFFICE
3 TOILET
4 STORE ROOM
5 FISHING GEAR STORE ROOM

TOTAL FLOOR AREA = 153 M²



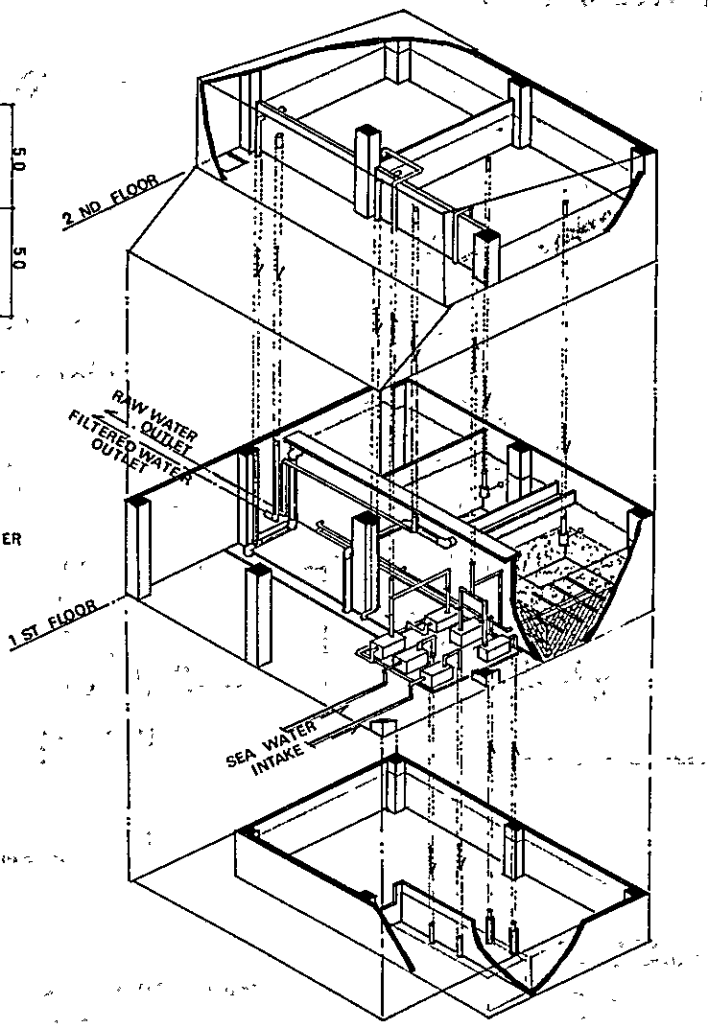
FLOOR PLAN S 1/200 M

1 SETTLING TANK
2 RAW WATER TANK
3 MACHINE ROOM
4 FILTERED SEA WATER TANK
5 FILTER TANK
6 ELEVATED TANK FOR FILTERED SEA WATER
7 ELEVATED TANK FOR RAW WATER



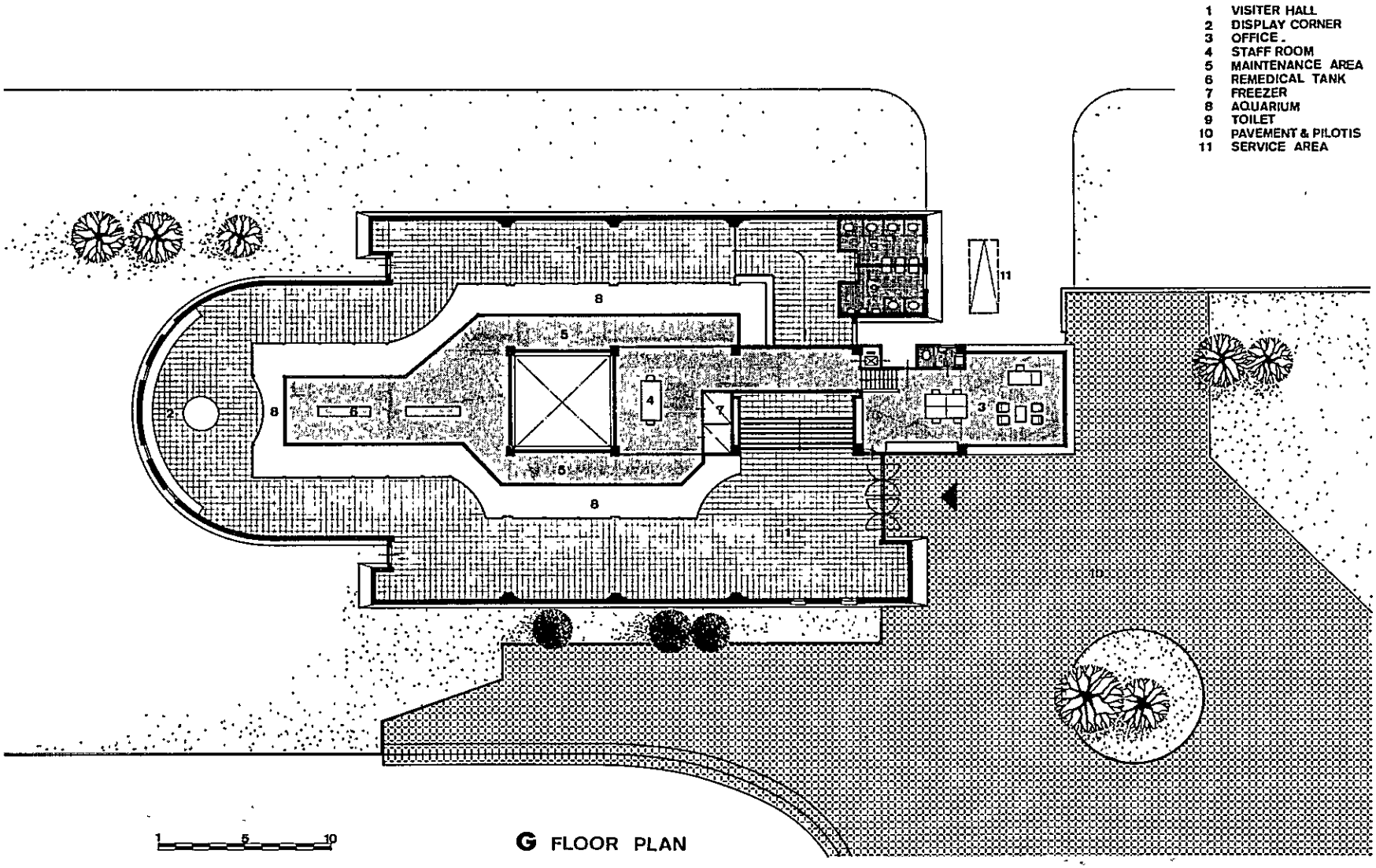
SECTION S 1/200 M

ELEVATION S 1/200 M



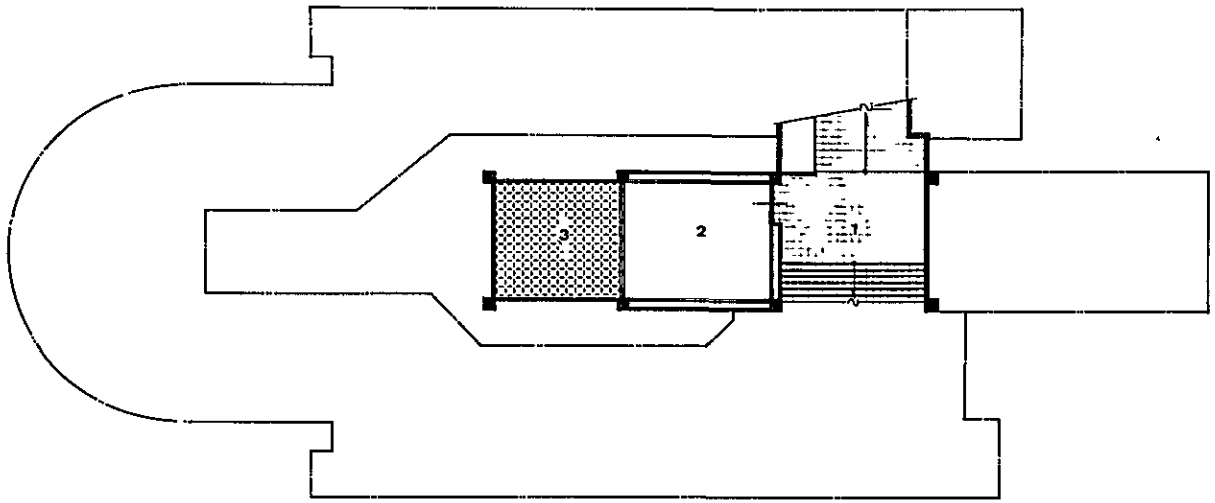
ISOMETRIC PAERSPECTIVE

FILTRATION & MACHINE BLDG



G FLOOR PLAN

AQUARIUM

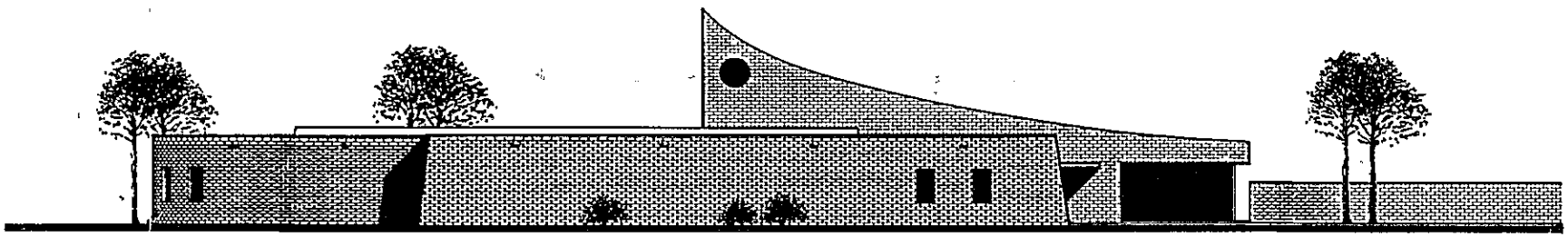


1 5 10

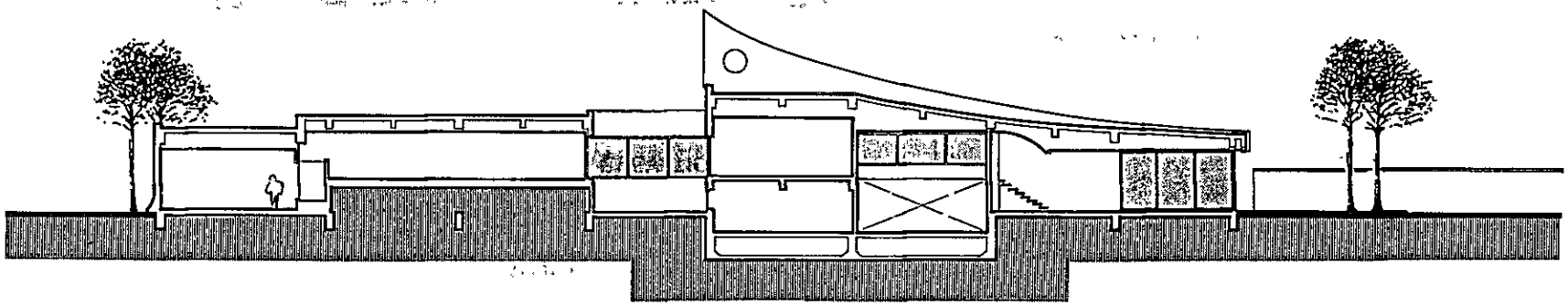
BASEMENT PLAN

1 VISITER HALL
2 MACHINE ROOM
3 DRY AREA

AQUARIUM

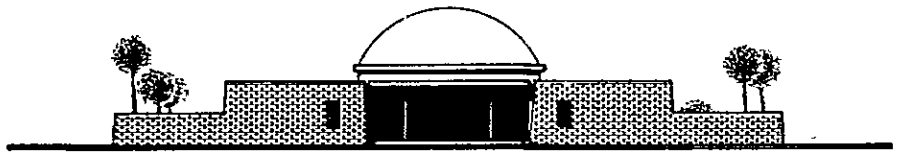


ELEVATION

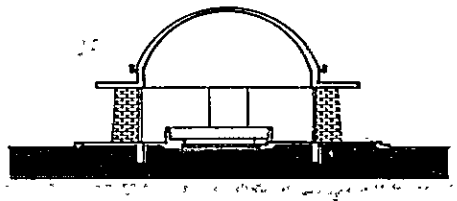


SECTION

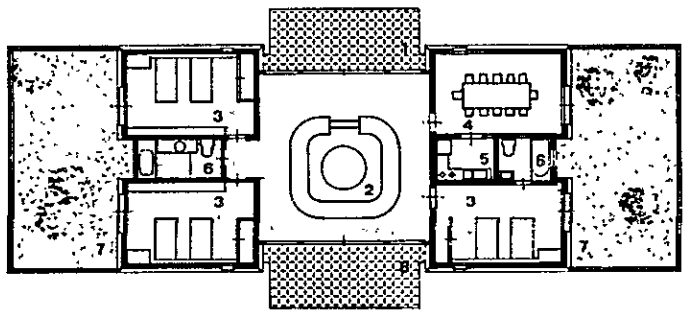
AQUARIUM



ELEVATION

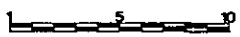


SECTION

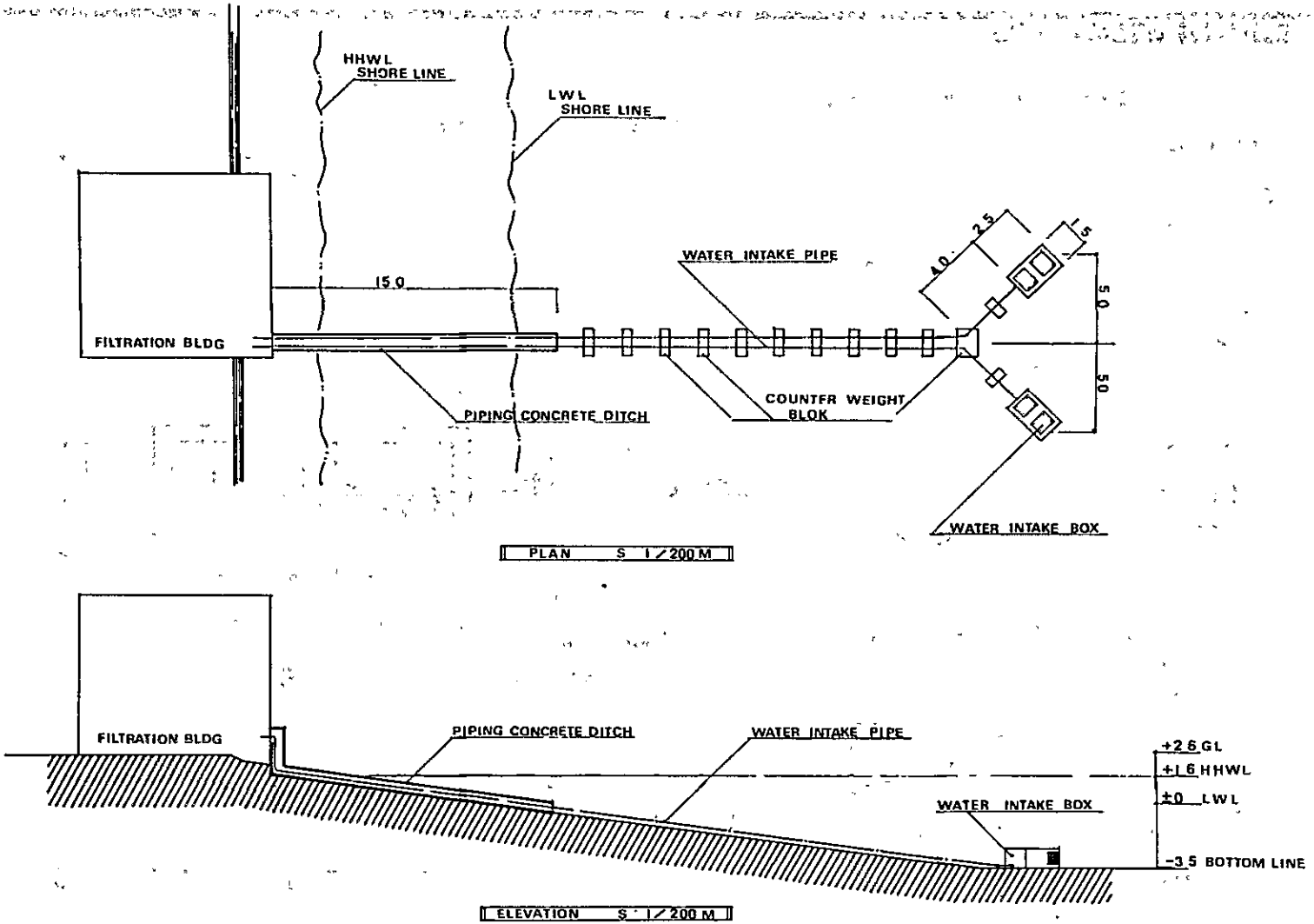


G FLOOR PLAN

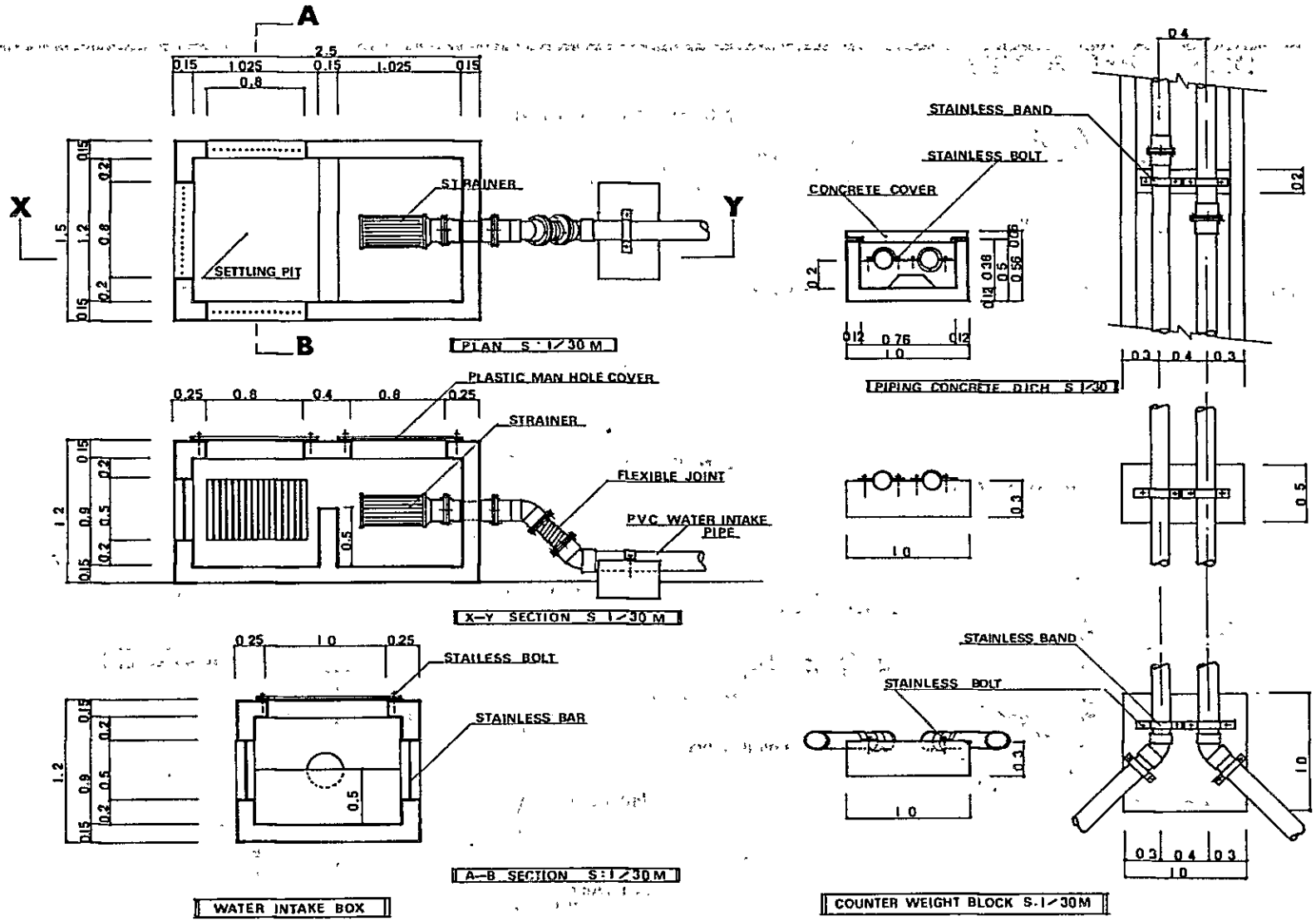
1 PORCH
2 LIVING RM
3 BED RM
4 DINING RM
5 KITCHEN
6 BATH RM
7 TERRACE
8 COURT



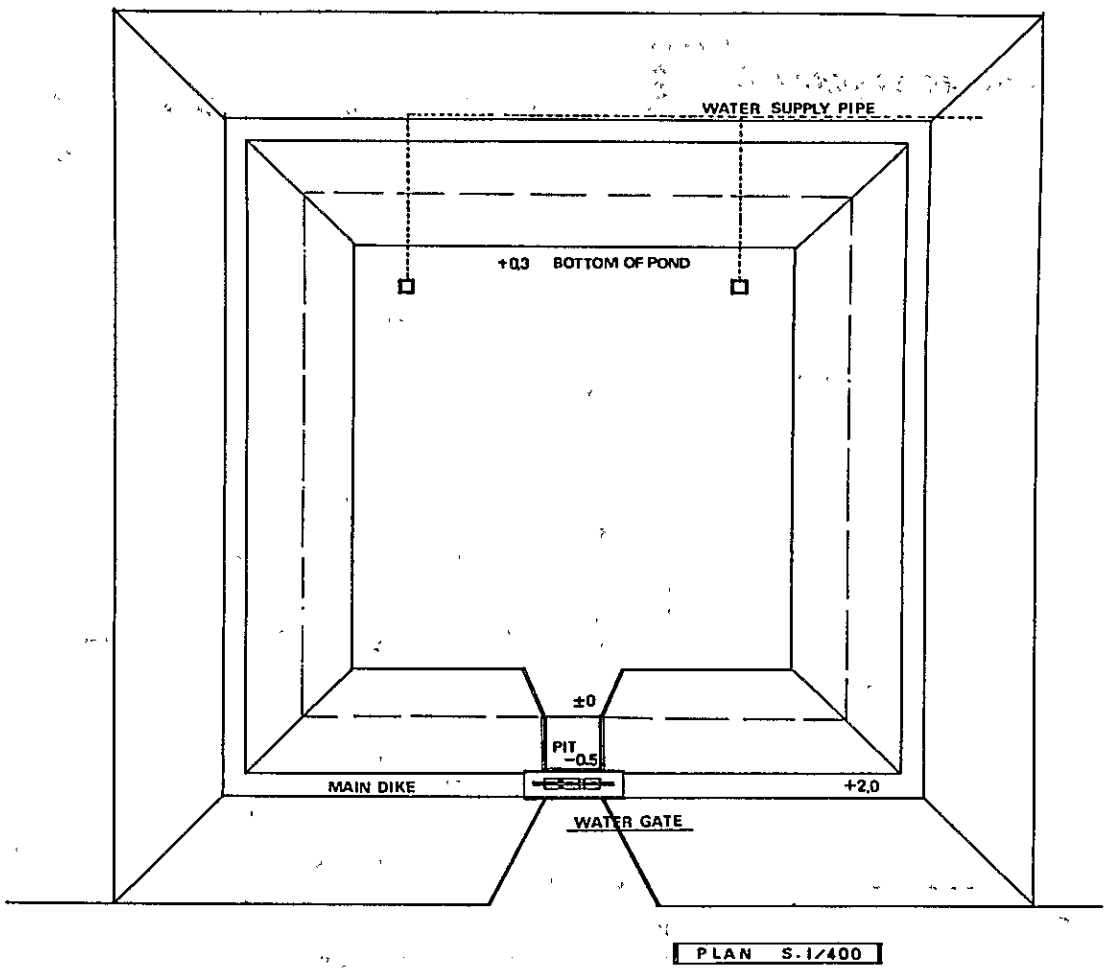
DORMITORY

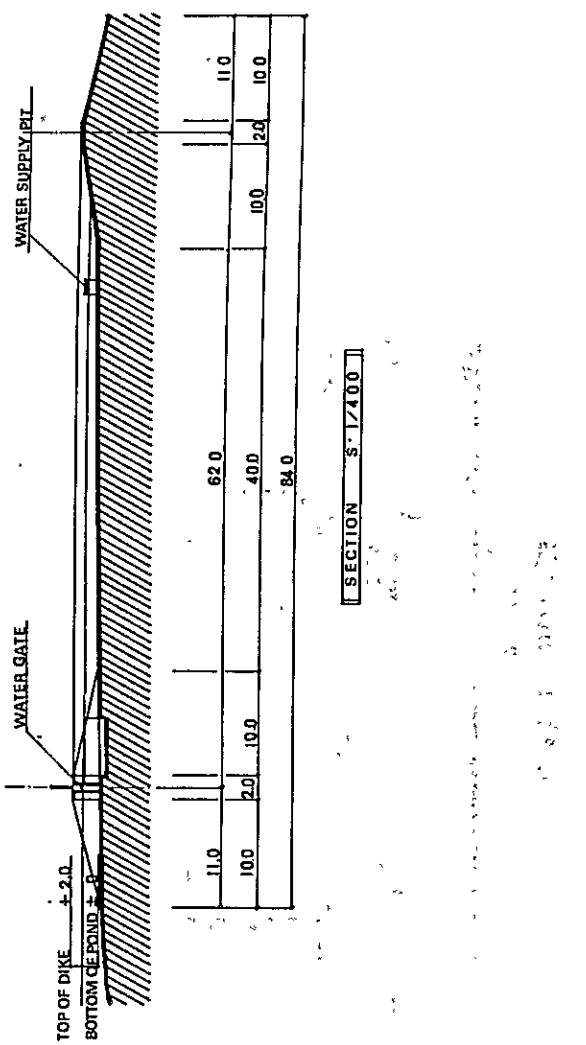


SEA WATER INTAKE



SEA WATER INTAKE DETAILS

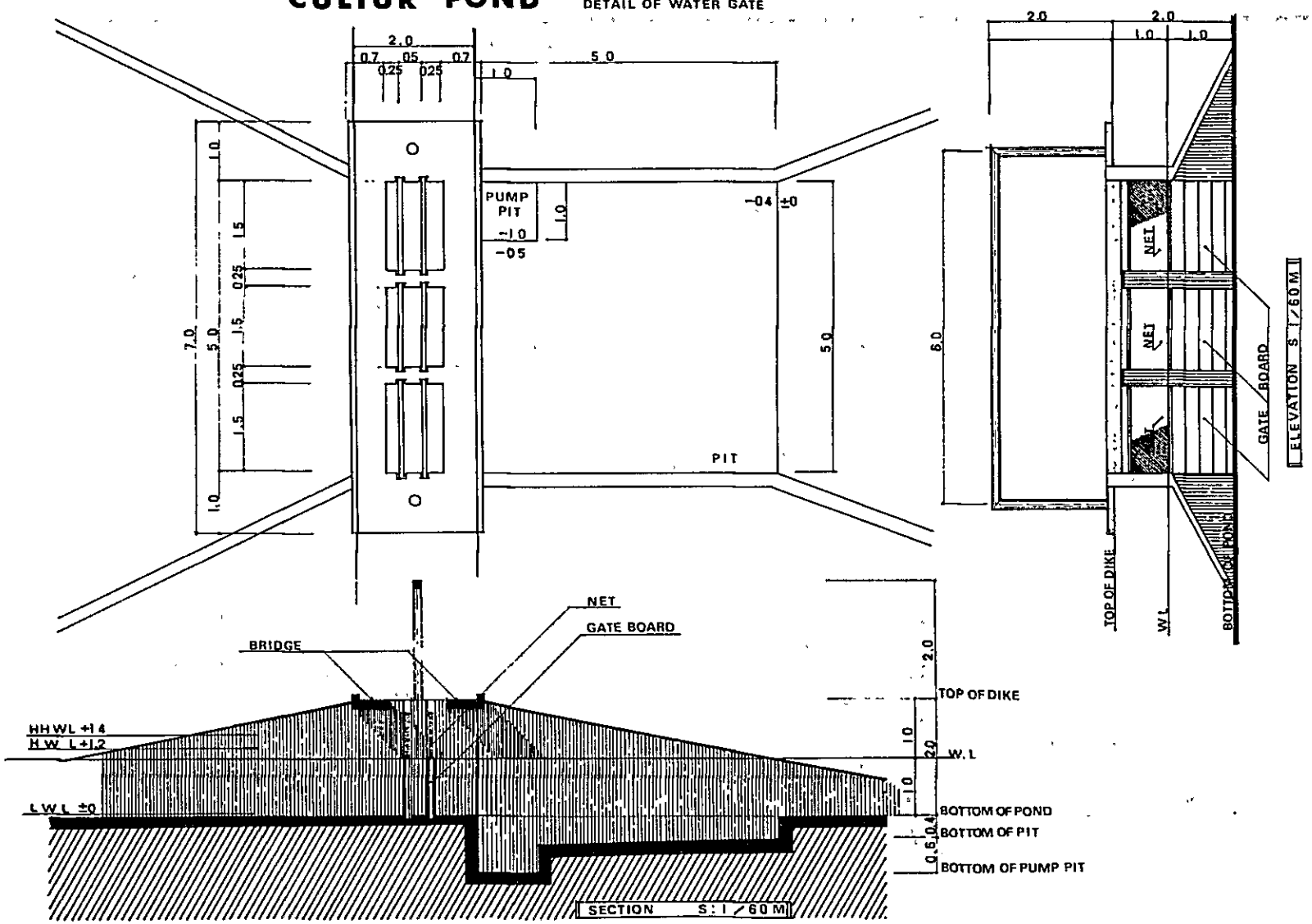

WATER SUPPLY PIPE
+0,3 BOTTOM OF POND
±0
PIT −0,5
MAIN DIKE
+2,0
WATER GATE
PLAN S.1/400


WATER SUPPLY PIT
WATER GATE
TOP OF DIKE +2,0
BOTTOM OF POND ±0
11.0
10.0
2.0
10.0
62.0
40.0
84.0
19.9
2.0
11.0
10.0
SECTION S.1/400

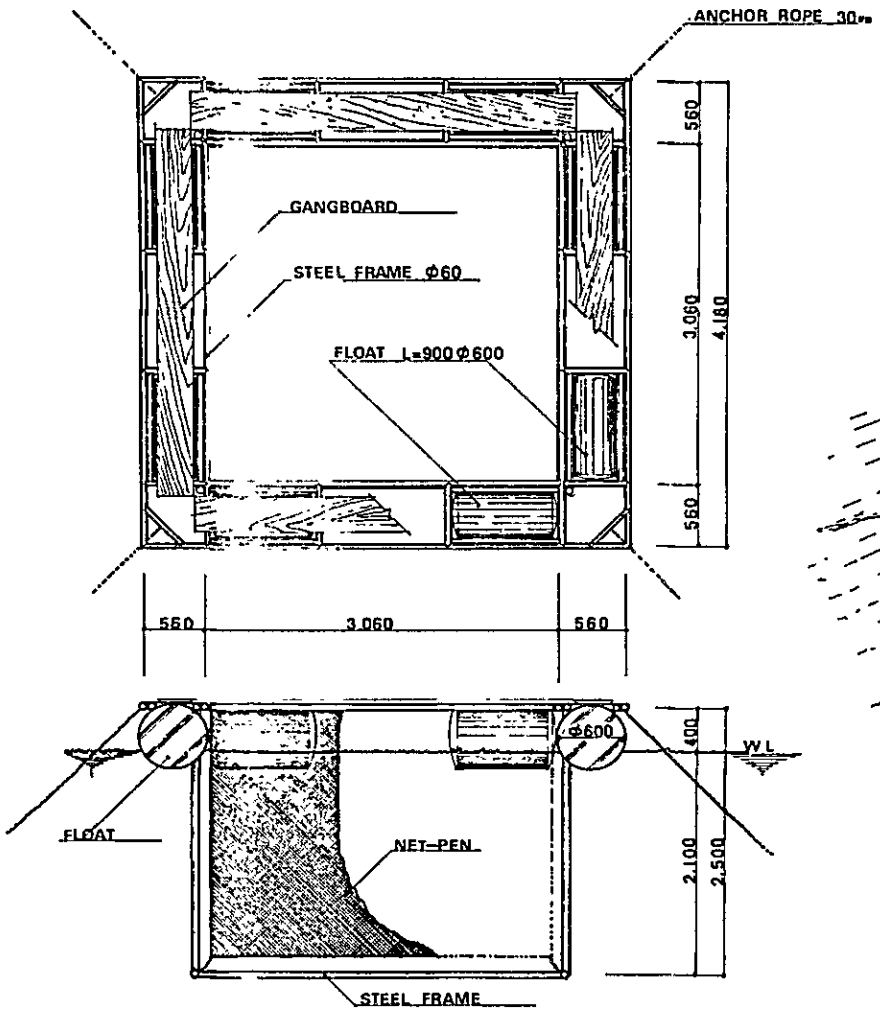
CULTUR POND

CULTUR POND

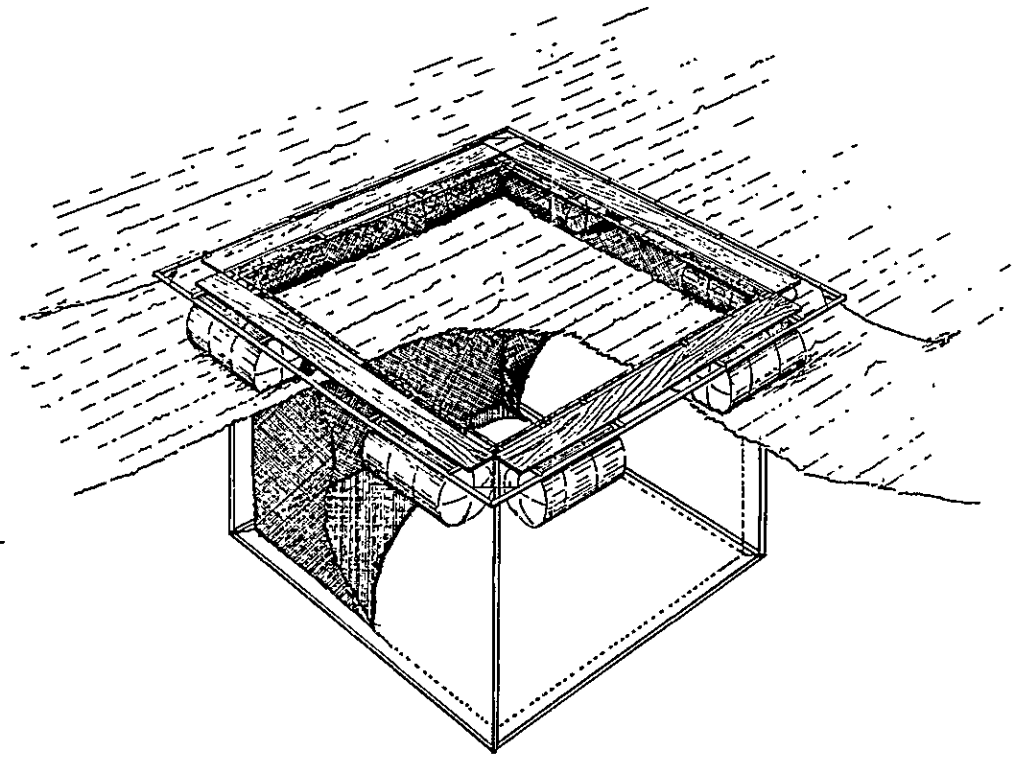
DETAIL OF WATER GATE



FLOATING NET-PEN S : 1/40

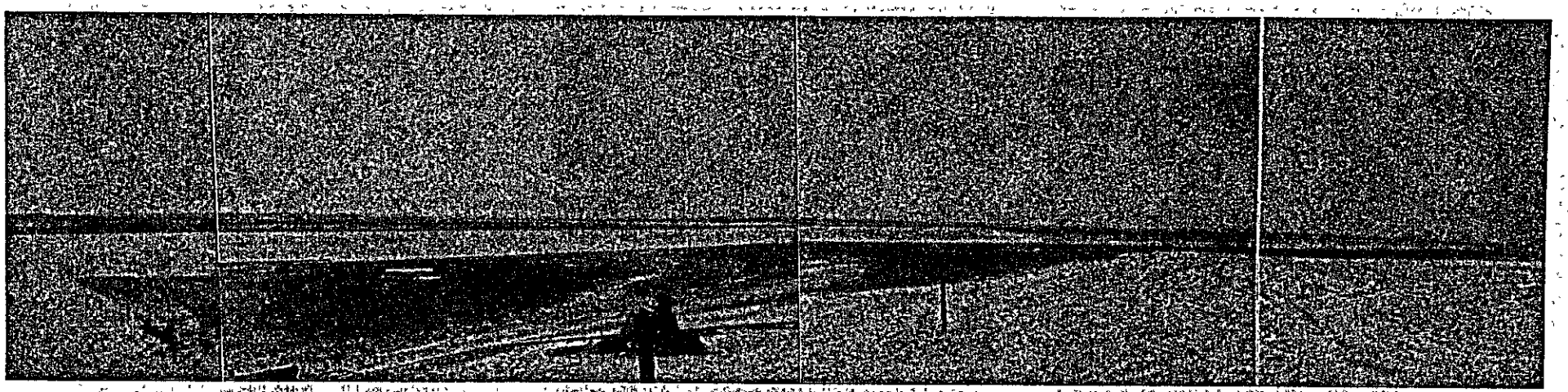


SECTION

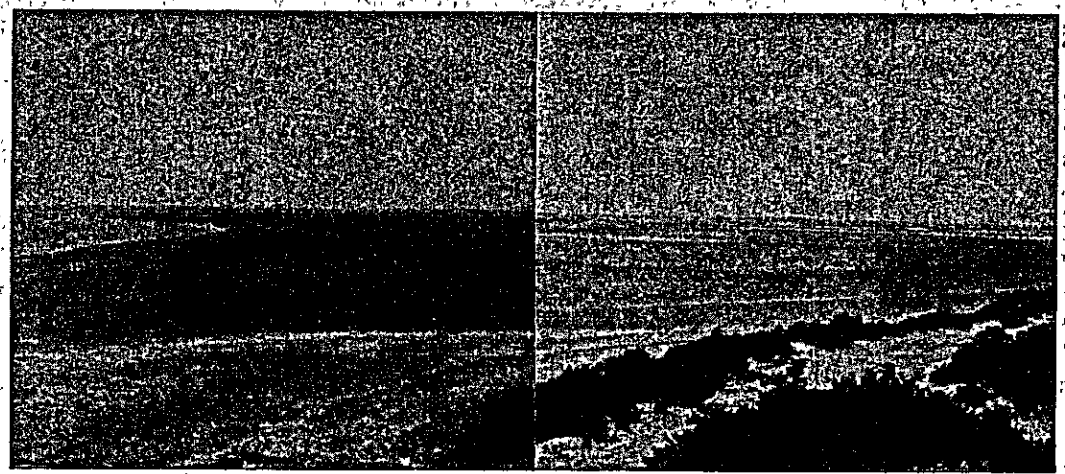


PERSPECTIVE

7. PICTURES

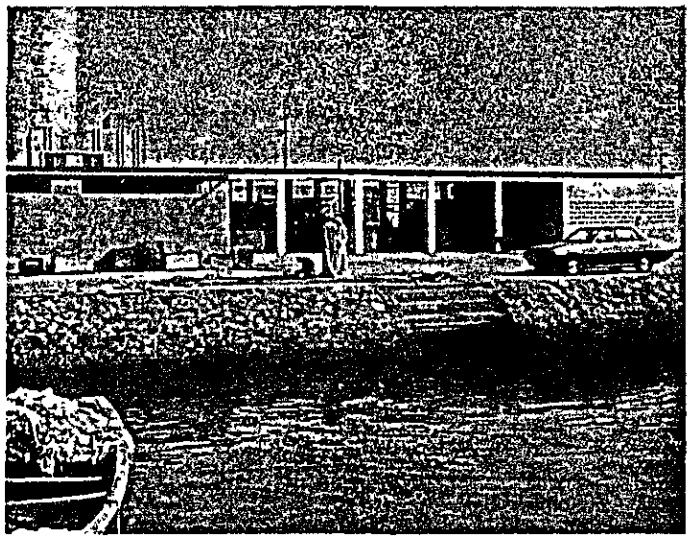


Proposed construction site



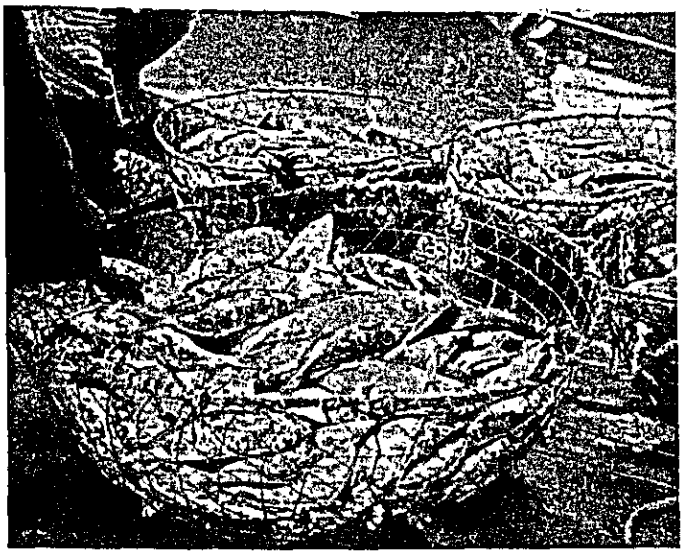
Alternative proposed construction site in Chaebe Island

Umm Al Quwain fish market

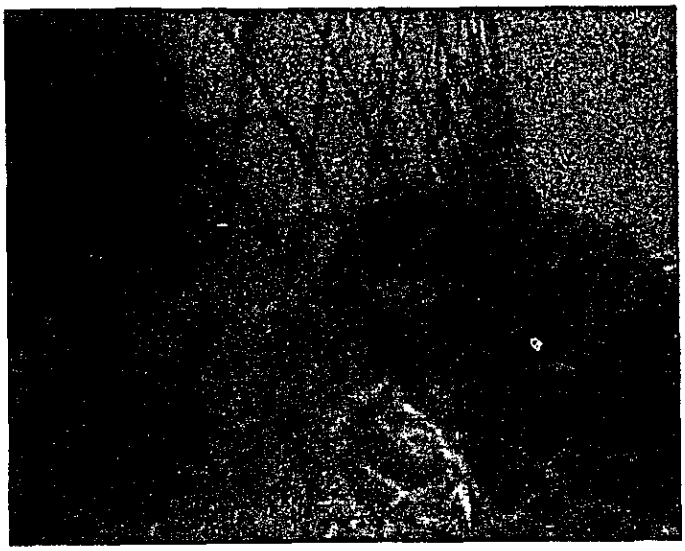


Umm Al Quwain fish market

Jetty



Rabbitfish landed



Rabbitfish caught by a trap

Mangrove swamp